

PowerWAVE 9000DPA

(30–50 kVA)

Parallelable up to 1.5 MVA

User Manual



Document Control

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1 Safety

1.1 Description of symbols used in this manual



WARNING: The warning symbol is used where there is danger of an electrical shock, equipment damage or personal-injury.



CAUTION: The caution symbol is used to highlight important information to avoid possible equipment malfunction or damage.

1.2 User precautions



WARNING: Keep this manual with the UPS for future reference.



WARNING: The UPS and peripheral equipment must be installed and commissioned by suitably qualified and trained personnel who are aware of the potential shock hazards.



WARNING: Do not attempt to install this UPS system until you are satisfied that ALL the safety instructions and hazard warnings contained in this manual are read and fully understood.



WARNING: High leakage current!
Ensure that the UPS has been correctly earthed before you connect the mains power supply!



WARNING: This UPS must not be started-up or put into use without having first been commissioned by a fully trained engineer authorised by the manufacturer.



WARNING: All servicing must be performed by qualified personnel. Do not attempt to service the UPS yourself.
You run risk of exposure to dangerous voltages by opening or removing the UPS-covers! Kohler Uninterruptible Power Ltd will assume no responsibility nor liability due to incorrect operation or manipulation of the UPS.



WARNING: The PowerWAVE 9000DPA is a Class A UPS product (according to EN 62040-3). In a domestic environment the UPS may cause radio interference. In such an environment the user may be required to undertake additional measures.

2 General Description

2.1 General introduction

Congratulations on your purchase of the PowerWAVE 9000DPA UPS.

Continuous power availability is essential in today's dynamic IT and process-related work environments. It is equally important that any installed power protection system is sufficiently resilient and adaptable to handle any changes brought about by the introduction of new server technologies, migration and centralization.

Such demands are well met by the PowerWAVE 9000DPA UPS system which provides the foundation for continuous power availability of network-critical infrastructures both in enterprise data centres, where business continuity has paramount importance, and in process control environments where manufacturing continuity is essential.

The PowerWAVE 9000DPA is a second generation high-power-density (HPD), leading-edge, double-conversion power protection technology that has standardised on a modular component approach which helps speed deployment, improve adaptability and increase system availability, while reducing total cost of ownership. It is a unique on-demand architecture that integrates the power rack, power distribution unit, back-up battery and monitoring and management solutions to allow easy selection of optimised configurations.

2.1.1 Reliability and quality standards

High reliability, upgrade ability, low operating cost and excellent electrical performance are just some of the highlights of this innovative UPS solution.

By using a unique modular construction, and incorporating the latest technological developments in power engineering, the PowerWAVE 9000DPA represents a completely new generation of transformerless 3 phase UPS-System. Its advanced double conversion VFI (Voltage and Frequency Independent) topology responds fully to both the highest availability and environmentally friendly requirements compliant with IEC 62040-3 (VFI-SS-111) standards. The criteria and methods which are used in the design, manufacture, and maintenance of Uninterruptible Power Supply systems are certified to International Standard ISO 9001/EN 29001 and ISO 14001. A full UPS Specification is given in Chapter 8 of this manual.

Kohler Uninterruptible Power Ltd. specialises in the installation and maintenance of Uninterruptible Power Systems; and this powerful UPS is just one example of our wide range of state-of-the-art power protection devices that will provide your critical equipment with a steady and reliable power supply for many years.

2.1.2 Advanced design features

Key features

The highlights of this innovative UPS solution include:

- *Decentralised Parallel Architecture (DPA)* – Highest availability, with near zero down time.
- *Truly modular design* – The PowerWAVE 9000DPA is designed around 30kVA, 40kVA, or 50kVA UPS modules.
- *Hot-swappable modules* – Enables system expansion and module replacement in a live system.
- *Compact size, small foot print* – Up to 342kW/m² saving on expensive floor space.
- *Flexible battery management* – Advanced management of battery charging and preventive-failure diagnostics.
- *High ac-ac efficiency (up to 95.5%) even with partial loads* – Results in energy and operational cost savings (TCO)
- *Full power available from 0.9 lead to 0.8 lag* – No de-rating required with leading power factor loads.
- *Very low input current distortion* – THDi = <3% @ 100% load leads to savings in generator-set power and installation costs.

Hot-swappable modules

In a redundant module system the unique 'hot-swappable' feature enables a UPS module to be added or removed from its cabinet whilst the system is still powered. This can be done without disturbing the load or transferring it to the bypass supply.

Note: In a non-redundant system the load will unavoidably have to be transferred to the bypass supply while a module is shut down or removed from the system.

Advanced booster technology

The UPS module's inbuilt advanced booster technology results in a perfect sinusoidal input power quality at 0.99 input power factor with a harmonic content of less than 3-4% THDi. This leads to a more reliable system operation together with savings in generator and transformer sizing due to reduced winding losses. It also means that the traditional input harmonic filters, still used by some systems, are not required.

The high power factor presented by the UPS on the incoming mains supply minimises cabling and fusing costs due to the reduced reactive power consumption which, together with the accompanying low harmonic currents, provides the following benefits:

- No additional losses in wires and cables
- No extra heating of transformers and generators
- No over sizing of generators
- No false circuit breaker tripping and malfunction
- No erratic operation of computers, telecommunications, monitors, electronic test equipment etc.
- No resonance with power factor correction capacitors

Decentralised Parallel Architecture (DPA)

The PowerWAVE 9000DPA system features DPA paralleling technology that provides n+x redundancy without introducing a single-point-of-failure. Each module contains its individual charger and inverter power units, bypasses, CPUs, control panels and separate battery configuration, and thereby offers completely autonomous operation.

This unique decentralized design:

- Enables a parallel redundant system providing 100% conditioned power at all time.
- Eliminates the system-level single point of failure inherent in traditional parallel UPS systems.
- Exponentially increases the reliability of the overall system.

Flexible battery management (FBM)

This equipment employs flexible battery charging management which avoids premature deterioration of battery life and provides preventive failure diagnostics. The major benefits are:

- AC-ripple-free battery charging due to a dedicated dc-dc charger independent from the rectifier and inverter.
- Wide range of number of battery blocks (42-50 x 12V blocks, depending autonomy times).
- Wide UPS input voltage operating window extends the battery life due to fewer discharge cycles.
- Battery discharge protection caused by load jumps.
- Proactive battery protection from false manipulations and inadequate charging voltages.
- Proactive battery failure detection thanks to the Advanced Battery Diagnosis (ABD) algorithm.
- User-selectable battery tests to ascertain the battery state.
- Optional temperature compensated charging regime to enhance battery life.

2.2 PowerWAVE 9000DPA Model range

The PowerWAVE 9000DPA UPS incorporates a rack-mountable design based on 30kVA, 40kVA and 50kVA plug-in UPS modules fitted into one of three purpose-built cabinets. Each module is a self-contained UPS comprising a rectifier, battery charger, inverter and static switch; and when two or more modules are fitted into a cabinet they effectively operate as a parallel UPS system. The available cabinets are shown below in Figure 2.1.



CAUTION: All the modules fitted within a cabinet must be of the same rating – for example, it is not possible to mix 30kVA and 50kVA modules in the same cabinet.

The PowerWAVE 9000DPA cabinets are identified as CLASSIC DPA-50, TRIPLE DPA-150 and UPGRADE DPA-250 – where the model number represents the maximum kVA output when the cabinet is fully populated with 50 kVA UPS modules. Figure 2.1 shows that the DPA-50 and DPA-150 cabinets also contain the UPS batteries; however the DPA-250 cabinet requires an external battery cabinet, or battery rack. Kohler Uninterruptible Power Ltd. can supply a matching battery cabinet which can be installed adjacent to the DPA-250 cabinet in the majority of installations. An external battery cabinet can also be added to the DPA-50 and DPA-150 models to extend the system's autonomy time if desired.




		CLASSIC DPA-50	TRIPLE DPA-150	UPGRADE DPA-250
				
UPS module capacity	Max	1 module (30-50kVA)	3 modules (30-50kVA)	5 modules (30-50kVA)
Battery capacity		280 x 7/9Ah batteries	240x 7/9Ah batteries	External batteries
Maximum power connection	kVA	50	150	250
Dimensions (WxHxD)	mm	730x1650x800	730x1975x800	730x1975x800
Weight of empty frame	kg	262	239	205
Weight of frame with modules fitted (but without batteries)	kg	305 - 309 (with 1 Module)	368 - 379 (with 3 Modules)	420 - 439 (with 5 Modules)
Colour		Black (RAL 9005)		

Figure 2.1 PowerWAVE 9000DPA Cabinets (frames)

		DPA 30 S2 Module	DPA 40 S2 Module	DPA 50 S2 Module
Output Apparent Power	KVA	30	40	50*
Output Active Power	KW	24	32	40
Output Power (PF=1)	KVA / KW	24 / 24	32 / 32	40 /40
Number of 12V Battery Blocks	No.	42-50	42-50	42-50
Dimensions (WxHxD)	mm	663 x 225 x 720		
Weight	kg	43.1	45.3	46.8
Colour		Black (RAL 9005)		
* On Inverter mode 50 KVA/40kW on Bypass mode 45 KVA/40kW				

Figure 2.2 PowerWAVE 9000DPA UPS Modules

2.3 Functional description of operation

This section describes:

- The internal operation of an individual UPS module at block-diagram level (see paragraph 2.3.1)
- The various operational modes of an individual UPS module (see paragraph 2.3.2)
- UPS system operational modes – ‘On-line’ versus ‘Off-line’ system operation (see paragraph 2.3.3)
- Multi-module system operation and paralleling considerations (see paragraph 2.3.4)

2.3.1 PowerWAVE 9000DPA module block diagram

The PowerWAVE 9000DPA UPS module is rack-mounted within the cabinet, and when the module is inserted into its rack it plugs into a heavy-duty connector fitted to the back of the rack which carries all the module's power connections – i.e. input mains, bypass mains, battery and module power output.

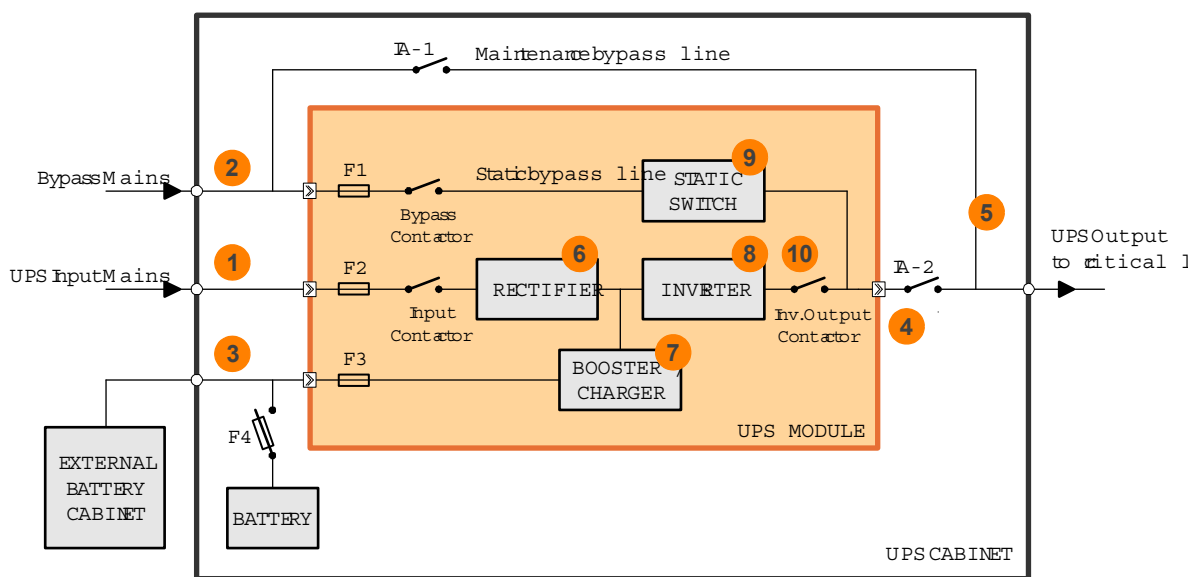


Figure 2.3 PowerWAVE 9000DPA module

Input power connections (1) / (2)

The UPS input mains and bypass mains are connected to an input power terminal block located in the lower part of the UPS cabinet. Both inputs require a 3ph+N feed but, although the two inputs are shown as being separate in Figure 2.3, in a standard installation the input mains terminals (1) and bypass mains terminals (2) are usually linked at the cabinet's input power terminal blocks so only one mains supply feed is required.

The input supplies are unswitched within the UPS cabinet and connected directly to each fitted module.



CAUTION: As the mains power supplies are unswitched within the UPS cabinet, the module(s) will be live at all times unless the input/bypass supply is isolated at the external mains switchboard panel.

Both input supplies are fused within the module (F1/F2), however the fuses are internal to the module and not accessible to the operator. In the event of a fuse failure the module must be removed and repaired by an authorised service agent. A fuse failure event is shown on the module control panel to identify a faulty fuse.

Within the UPS module, the input supplies are connected to the module's power blocks through individual supply contactors which are driven by the module's control logic and operate as part of the module's start/stop sequences. They are also used by the control system to isolate the input power within the module following certain fault conditions.

Battery connections (3)

Each UPS module is connected to a battery string via a dedicated fused isolator. Ideally, each module is connected to an individual battery but in some installations a common battery is shared between two (or more) modules.

The battery fuse (F3) is fitted inside the module and is not accessible to the operator. If the fuse ruptures, the module must be removed and repaired by an authorised service agent. A fuse failure message is shown on the module control panel.

- DPA-50 (1 module) – The batteries are housed internally in the UPS cabinet and connected to the module through a fused isolator (F4) located on the cabinet's power panel.
- DPA-150 (3 modules) – The batteries are housed internally in the UPS cabinet and connected to the module through three fused isolators annotated F4/ F5/ F6 (for modules 1, 2, and 3 respectively).
- DPA-250 (5 modules) – The batteries are housed in a separate battery cabinet (or rack) which must also contain the fused isolators. There are no battery isolators within the UPS cabinet itself.

Output power connection (4)

A 'parallel isolator' switch (IA-2) is connected between the UPS module output and the cabinet's output (load) terminal block. IA-2 is used to disconnect the module from the UPS output; for example, when replacing a module in a redundant parallel system, or when operating on maintenance bypass.

In the DPA-150 and DPA-250 cabinets, a dedicated 'parallel isolator' switch (IA-2) is provided for each UPS module. The isolators are located on the cabinet's power panel and identified as IA2-1, IA2-2, IA2-3.... (for modules 1, 2, and 3 respectively)

Maintenance bypass (5)

The maintenance bypass switch (IA-1) is external to the UPS module(s) and located on the cabinet's power panel. This switch connects the UPS cabinet output (load) terminals directly to the bypass mains terminals and is used to connect the load to the (unprotected) bypass supply if the UPS modules have to be shut down due for service repair etc. See also paragraph 3.4.2.

Rectifier (6)

The rectifier converts the UPS input mains supply into a regulated DC power source which provides the operating power for the inverter. It uses leading-edge switched-mode techniques which results in a UPS module input power factor of almost unity over its operating range (0.99 at full rated linear load). The rectifier can provide 100% inverter power demand over an input voltage range of -20% to +15%. This wide input voltage operating range means that the battery is not called upon during substantial power dips (brown outs), which in turn maximises the battery life and availability.

Battery booster/charger (7)

This block has bi-directional functions. When the input mains supply is available, and the rectifier is turned on, the booster/charger acts as a multi-stage battery charger. The charger uses an intelligent charging profile to optimise the battery life and at the same time ensure the battery recharges quickly following a deep discharge cycle.

If the input mains supply fails, or the rectifier is unable to provide a sufficient output to satisfy the prevailing inverter load, the battery provides the inverter's DC operating power source. The booster/charger circuit boosts the battery voltage as the battery discharges and regulates it at a suitable level to allow the inverter to operate correctly.

Inverter (8)

The inverter converts the DC voltage produced by the rectifier (or the battery via the DC boost converter) into a sinusoidal AC output voltage suitable to connect to the load. In addition to providing output voltage regulation, the inverter control logic also provides various levels of overload protection, frequency regulation and synchronisation, and output voltage error detection.

Static switch (9)

The static switch provides a means of connecting the UPS module output to the static bypass line – which is in turn connected to the UPS bypass mains supply. Working in conjunction with the output contactor, the static switch control logic is used to transfer the UPS output between the inverter and bypass mains without a break in the load supply.

Note: A brief load break will occur if transferring from bypass to inverter following a bypass supply failure. (See 'Off Line Mode' in paragraph 2.3.3).

Inverter output contactor (10)

The inverter output contactor is driven by the UPS module's control logic and operates in conjunction with the static switch as part of the bypass/inverter load transfer process. The contactor is also used to isolate the inverter from the UPS output within the module following certain overload or fault conditions.

2.3.2 UPS Module operating modes

Simplified block diagrams are used in this section to illustrate the various UPS module operating modes. Note that where two or more UPS modules are installed in a DPA-150 or DPA-250 cabinet they will always adopt the same operating mode due to their parallel control signals.

Load on inverter

This is the only operating mode that provides the load with continuously processed and backed-up power: and in the majority of installations can be considered as the 'normal' operating mode.

In this mode, the input mains AC supply is converted to DC by the rectifier which then charges the battery and provides the operating power for the inverter.

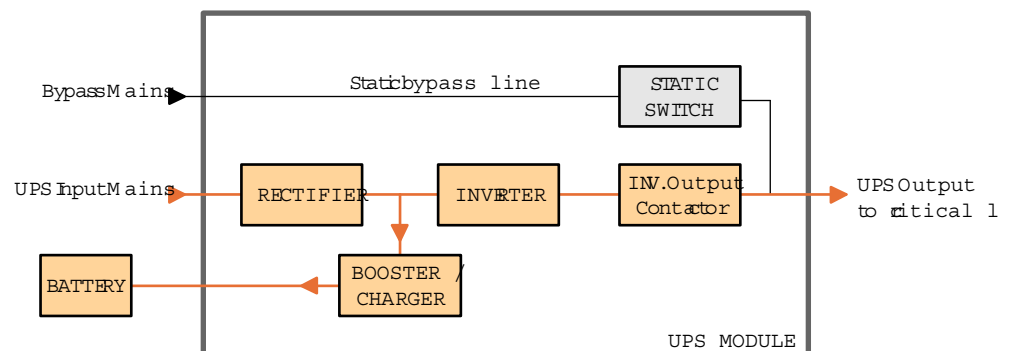


Figure 2.4 Load on inverter

The inverter converts the DC produced by the rectifier back to an AC power source which is then connected to the load via the inverter output contactor. The inverter frequency is synchronised to the bypass supply provided the bypass frequency remains within preset limits. If these limits are exceeded, or if the bypass supply fails altogether, the inverter frequency control reverts to a free-running oscillator which produces a constant 50Hz or 60Hz UPS output.

Load on battery

If the mains supply fails, the rectifier shuts down and the battery provides the DC power source for the inverter. The battery voltage is regulated by the booster circuit to ensure the inverter receives a suitable DC input as the battery discharges. On the module control panel the BATTERY LED will flash green to indicate that it is on load.

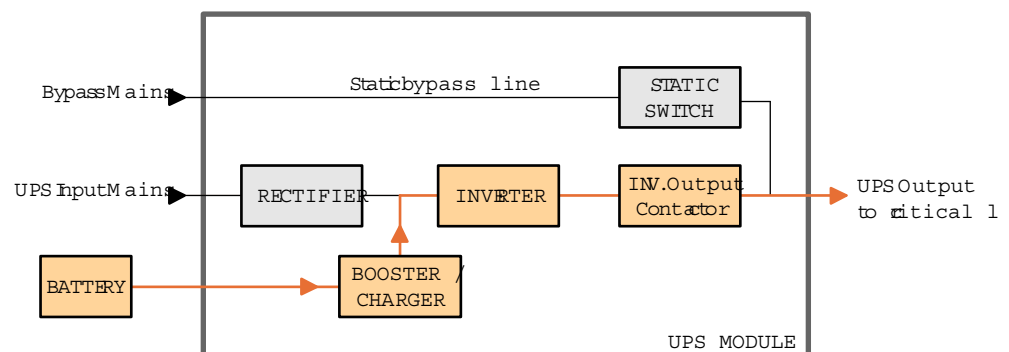


Figure 2.5 Load on battery

In the case of a dual feed input – if the bypass supply is still live when the input mains supply fails, the inverter frequency remains synchronised to the bypass mains provided it is within its preset limits.

In the case of a single feed input – the bypass supply will fail at the same time as the input mains supply and the inverter frequency control reverts to its free-running oscillator and will provide a constant 50Hz or 60Hz UPS output.

Battery discharge operation

When the battery is placed on load, and begins to discharge, the BATTERY mimic LED flashes green on the module control panel accompanied by an audible alarm. The LED continues flashing green until the remaining autonomy time falls

to three minutes, whereupon it begins flashing red. This allows the operator to gauge the remaining autonomy time and, where necessary, shut down the load in an orderly manner (e.g. save data) before the battery is fully discharged. Various options are available to automate the load shut down process and if an automated data protection application is installed it usually begins its automatic shut down routine at this point.

The initial audible alarm can be cancelled but it will reappear when the battery voltage falls to its LOW BATTERY alarm threshold, whereupon the audible alarm sounds once again to warn the operator that the battery is nearing its end-of-discharge.

Eventually, the BATTERY LED changes to solid red when the battery reaches its fully discharged voltage, and the UPS will attempt to transfer the load to the bypass supply if the supply is present.

Load on bypass

In the 'load on bypass' mode the static switch connects the load to the unprotected static bypass line.

This mode can be selected manually (see 'ECO Mode' below) or entered as the result of a UPS fault (or overload) condition which transfers the load to bypass because the inverter is unable to support it.

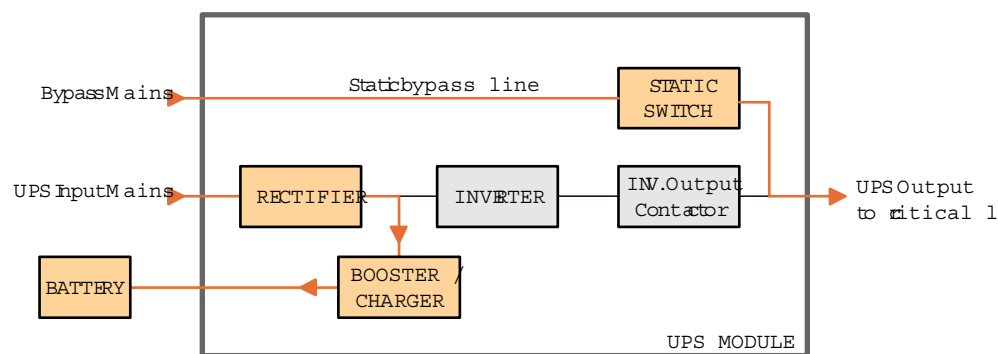


Figure 2.6 Load on bypass

Depending on the reason for entering the 'load on bypass' mode, the rectifier and charger sections might be turned off entirely or remain operational and continue to provide battery charging (as shown above). Similarly, the inverter may have been manually turned OFF or shut down due to a fault, and the INVERTER LED on the module control panel may be either OFF or solid RED.

Module OFF (Maintenance bypass)

When the UPS module is turned OFF, all of its internal power blocks are effectively shut down but the module input power terminals remain live unless the UPS input/bypass mains are externally isolated.

The maintenance bypass switch (IA-1) can be closed to maintain the load supply, but in a single UPS cabinet installation this requires the bypass mains supply to remain live and thereby prevents the bypass supply from being externally isolated.

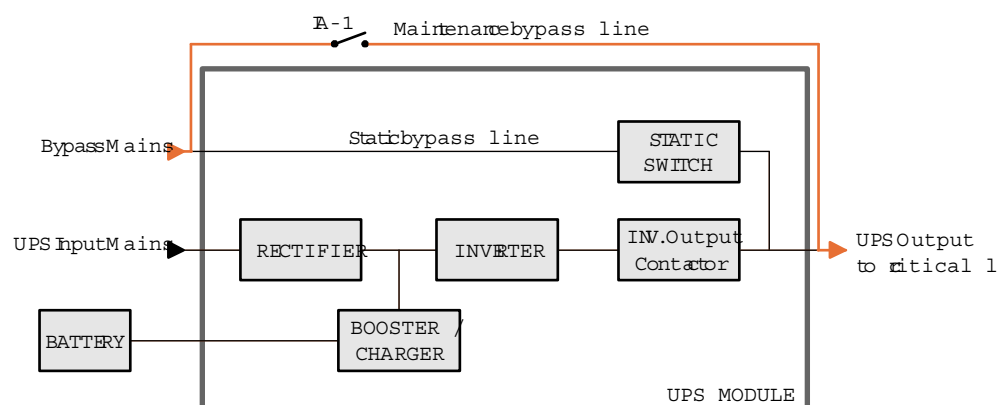


Figure 2.7 Module OFF (Load on maintenance bypass)

Only one maintenance bypass switch is fitted per UPS cabinet and if the cabinet contains several modules (DPA-150, DPA-250) the maintenance bypass switch (IA-1) bypass them all.

When operating a multi-cabinet system, the internal cabinet maintenance bypass switch (IA-1) should not be used, and an external maintenance bypass installation that wraps-around the complete multi-cabinet system is required – usually installed in a dedicated maintenance bypass cabinet, or wall-mounted as described in paragraph 3.4.2.

2.3.3 UPS System operating modes

Section 2.3.2 described the operating modes for the individual UPS modules: but UPS systems are also categorised according to the way in which they operate at a 'system' level, and are typically described as being either an 'on-line', or 'off-line' ('line interactive') system.

The PowerWAVE 9000DPA can be operated in either of these categories.

ON-LINE UPS system

An 'on-line' system provides the highest degree of load protection, especially if the utility mains supply suffers a disturbance or complete failure, and we always recommended this mode of operation if the critical load will not tolerate even a very brief supply interruption – e.g. in the case of a computer system.

When the PowerWAVE 9000DPA is used as an 'on-line' system, the UPS modules normally operate in their 'on inverter' mode (Figure 2.4), and switch to the 'on battery' mode if the input mains supply fails (Figure 2.5). The changeover to battery operation is totally transparent at the UPS output and an audible and visual alarm warns the operator that the battery is discharging to enable any intervention to be taken to protect the load integrity.

The UPS then continues to provide its rated output until the battery discharges to a low cut-off point at which time the UPS attempts to switch to its 'on bypass' mode. If the bypass is unavailable the UPS shuts down in a controlled manner.

It is usual, especially in larger installations, to provide the UPS with an alternative input supply from a standby generator which starts automatically following a UPS input mains failure; and where this is implemented the batteries only discharge for a short period, until the generator comes on-line. This not only avoids the UPS shutting down due to a fully discharged battery but also helps maximise the battery life cycle.

If the UPS experiences an internal fault during 'on-line' operation, the inverter turns off and the static switch transfers the load to bypass mains automatically and without interruption – provided the inverter is synchronised to the bypass. If there is an output overload, the inverter can supply the overload for a limited time, depending on its severity, and if the permitted time is exceeded the load transfers to bypass. The additional power available from the bypass supply will attempt to clear the overload but if it persists it will ultimately rupture the bypass mains supply fuses. If the overload condition clears while operating on bypass it re-transfers the load to the inverter and the UPS returns to its normal 'on-line' mode of operation.

OFF-LINE (On stand-by) UPS system operation

When the PowerWAVE 9000DPA is used as an 'off-line' system, the UPS modules are normally operated in their 'on bypass' mode (Figure 2.6) with the load supplied via the static bypass line. However the rectifier and battery charger are still powered up and maintain battery charging, and the inverter section is turned on and operating on standby.

Operating in this mode is slightly more energy efficient than operating in the 'on-line' mode due to the reduced rectifier and inverter losses during normal system operation; and it is sometimes referred to as the "ECO" (economy) mode. However, this mode is recommended only if the connected load equipment can tolerate power interruptions of up to 3~5 ms during the transfer period.

If the bypass supply fails, the inverter is immediately brought on line and the load is transferred from the bypass line to the inverter within 3 to 5 milliseconds. If the UPS bypass mains and input mains are connected to separate sources (dual feed) and the input mains is still live when the load is transferred, the UPS modules will operate in their 'on inverter' mode (Figure 2.4). However, if the input/bypass mains supplies are connected to a common feed, or the input mains is unavailable in a dual feed system, the modules immediately revert to the 'on battery' mode (Figure 2.5).

When the bypass supply returns to normal, the load re-transfers to the static bypass line (without a break) and the inverter returns to its standby operation.

Note: if the bypass is unavailable it is unable to take over the load supply if the inverter fails, or assist the inverter handle an output overload. It is therefore important that the cause of the load transfer from bypass to inverter is quickly rectified.



WARNING: The ON-LINE mode should always be used for critical load protection.

2.3.4 Parallel system operation

All the modules fitted in a UPS cabinet inherently operate as a parallel system as their outputs are connected in parallel at the cabinet's output terminals. The electronic control system built into each module ensures that:

- The modules are always frequency-synchronised to each other – and to the bypass mains (when present).
- The modules equally share the load current.
- The modules' load transfer operation is synchronised such they ALL transfer their output between inverter and bypass simultaneously when commanded from any one module.

The PowerWAVE 9000DPA UPS system can be expanded by connecting up to six PowerWAVE 9000DPA UPS cabinets in parallel; and when two or more cabinets are connected in this way, all the UPS modules within them are effectively paralleled together. For example: a maximum system capacity is obtained by connecting together six DPA-250 cabinets, each fully populated with DPA-50 modules, which results in a total of thirty (50kVA) modules operating in parallel to provide a system capacity of 1500kVA.

System expansion

Some UPS applications present a low initial power requirement which increases over time as the application grows; and it is therefore essential that the installed UPS system can be expanded to meet the growing demand without compromising the existing load. This requirement is well met with the 'hot swappable' feature of the PowerWAVE 9000DPA UPS modules, whereby an additional module can be inserted into a vacant slot in an existing cabinet without disturbing the load.

Note: If the expansion requires an additional cabinet the system will have to be shut down while the cabinet is installed.



Key Point: When planning a multi-cabinet system, it is not necessary to fully populate one cabinet with UPS modules before installing the next cabinet. For example, if it is known at the outset that a 200kVA initial load requirement is likely to increase to 400kVA, it makes sense to install and cable-up two DPA-250 cabinets and distribute the initial requirement of four UPS modules between them.

'Capacity' versus 'redundant module' system

A parallel UPS system can be operated as either a 'capacity' or 'redundant' module system.

A 'capacity' system is rated such that ALL the UPS modules are required to furnish the specified full load power and the loss of one module will automatically transfer the load to the bypass supply.

In a 'redundant-module' system, the system contains at least one UPS module over and above that required to supply the full load and it is possible to lose a module without transferring the load to the bypass supply or in any way disrupt the UPS output. A system operating with a redundant module is inherently the most reliable.

A parallel system operating with one redundant module is known as an 'N+1' system.

Parallel control bus

All the UPS modules within a cabinet, and between cabinets, are connected to a parallel control bus which carries several control signals used for frequency synchronisation, load sharing etc. Each UPS module can electronically compare its own frequency and output current with that of its neighbouring module and make any necessary fine adjustments to its control logic to achieve balanced conditions across the system.

The parallel control logic observes one UPS module as being the 'master' and the others as 'slaves'. However if the 'master' module goes faulty at any time the next module in the chain (a former 'slave') will immediately take over the role of 'master' and the former 'master' module will turn off. The 'master/slave' configuration is set during commissioning.

During commissioning, the UPS modules are also assigned a numerical ID according to their position in the cabinet, with the bottom module being given the lowest number. Figure 2.8 shows two DPA-250 cabinets with the modules in cabinet 1 assigned an ID of 'P01' to 'P05' and those in cabinet 2 an ID of 'P06' to 'P10' ('P' indicates that the modules are part of a Parallel system). The module ID is used by the control and monitoring logic.

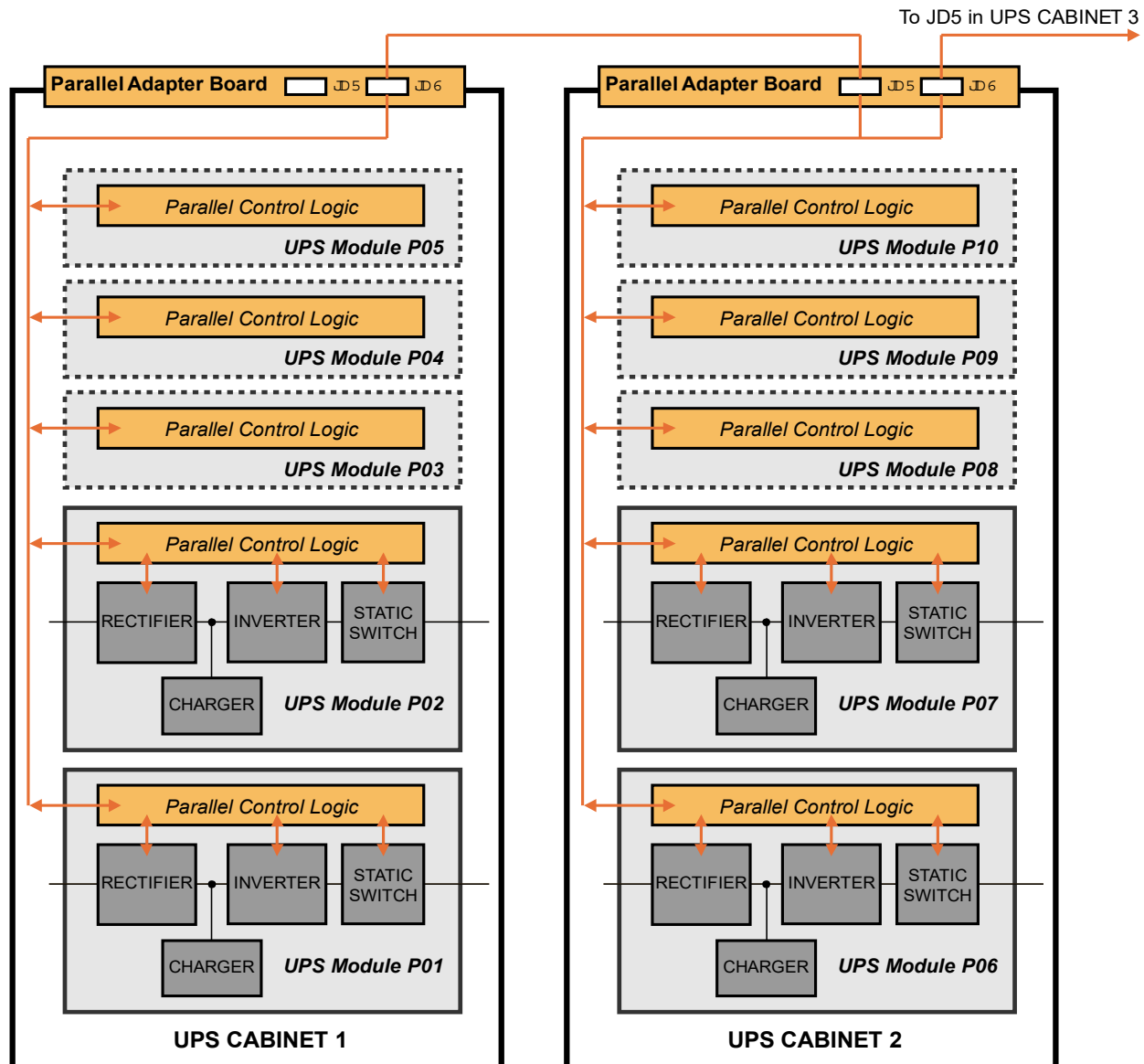


Figure 2.8 PowerWAVE 9000DPA – Parallel cabinet system

2.4 PowerWAVE 9000DPA User controls

The following illustrations show the location of the PowerWAVE 9000DPA power switches and fused isolators that are used when operating the equipment. The module control panel (one per UPS module) is described in paragraph 2.6.

2.4.1 DPA-50 Component identification

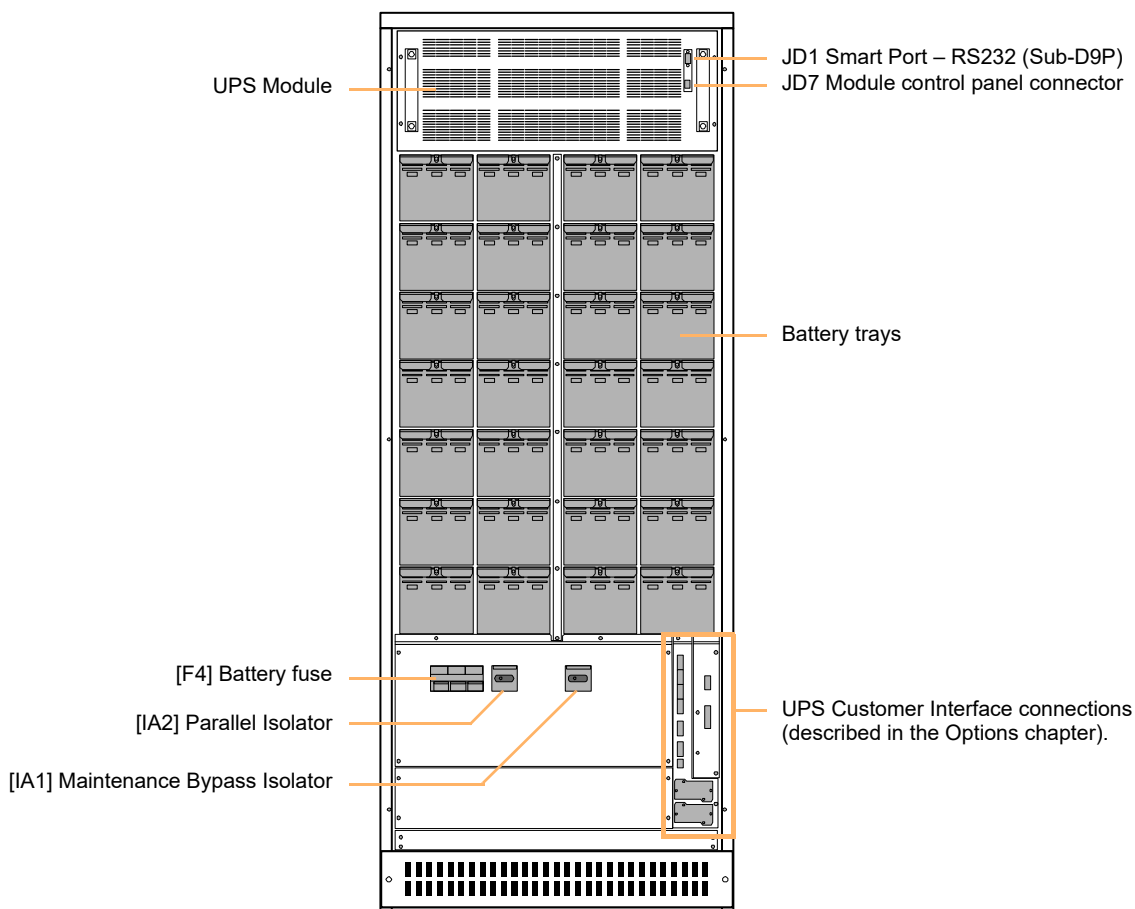
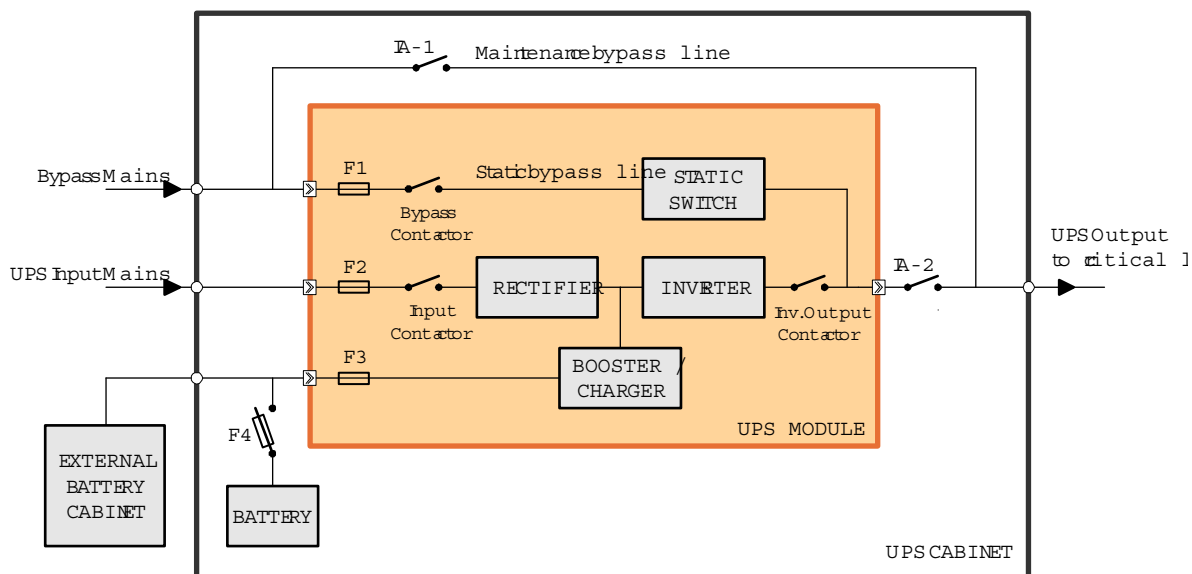


Figure 2.9 DPA-50 Cabinet details

2.4.2 DPA-150 Component identification

Up to three UPS modules can be fitted, with the lower-most module identified as module 1.

The battery fuses are identified F4 to F6. F4 is associated with module 1, F5 with module 2 and F6 with module 3.

The parallel isolator switches (IA2) are labelled to identify their associated UPS module – e.g. IA2-2 pertains to module 2.

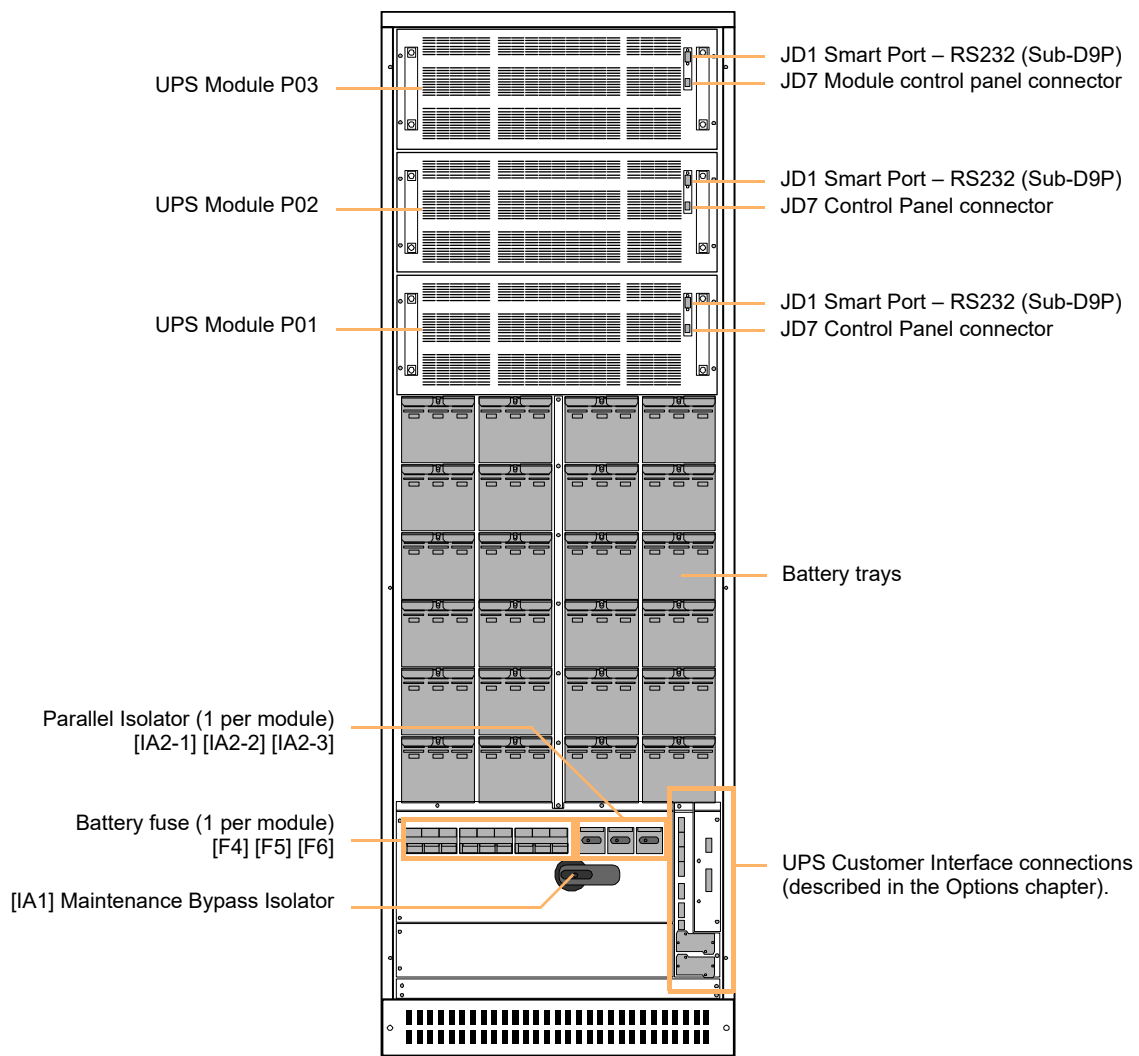


Figure 2.10 DPA-150 Cabinet details

2.4.3 DPA-250 Component identification

The DPA-250 contains no batteries and can be fitted with up to five UPS modules, with the lower-most module identified as module 1.

The module parallel isolator switches (IA2) are labelled to identify their associated UPS module – e.g. IA2-2 pertains to power module 2.

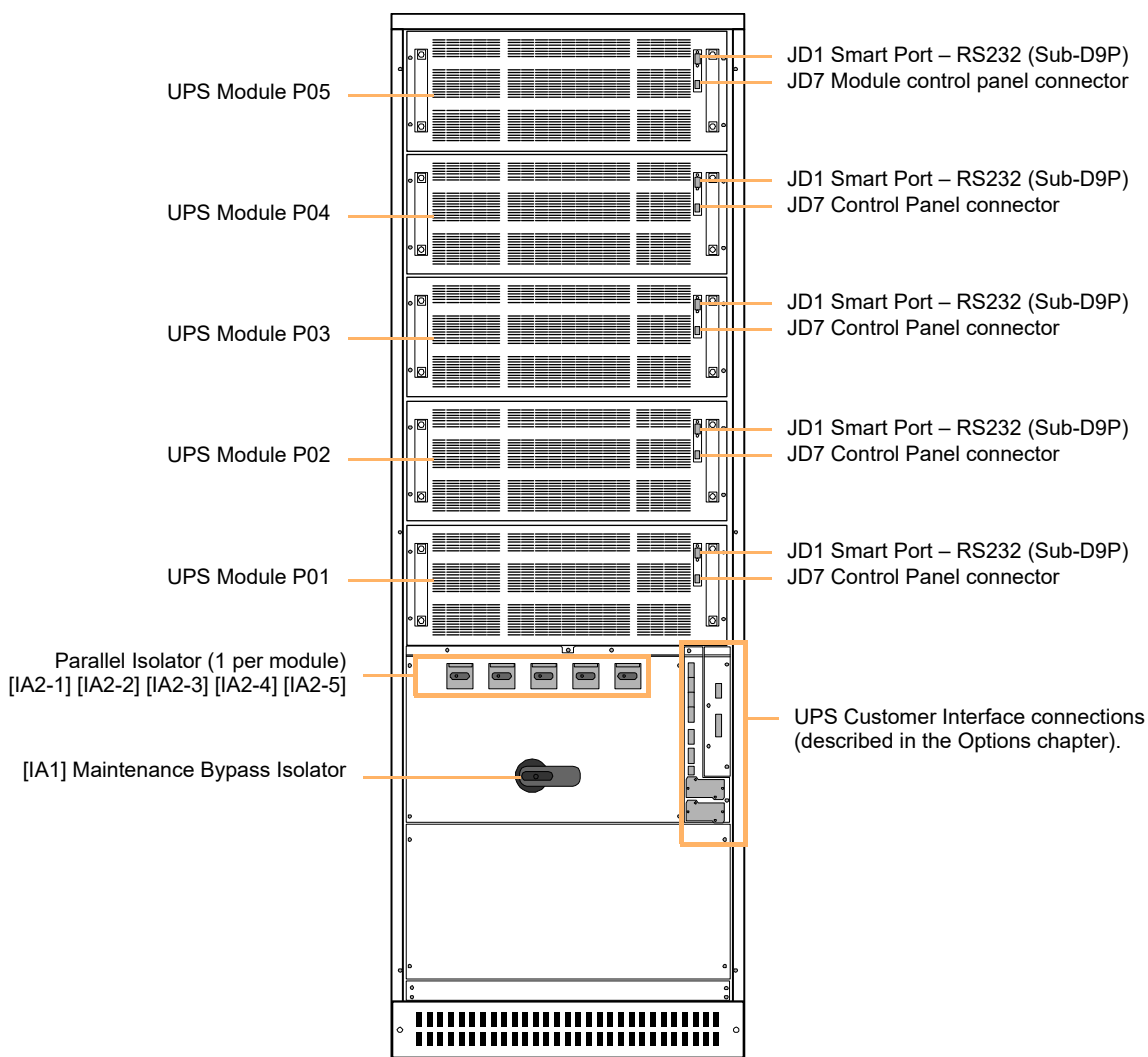


Figure 2.11 DPA-250 Cabinet details

2.5 UPS Interface facilities

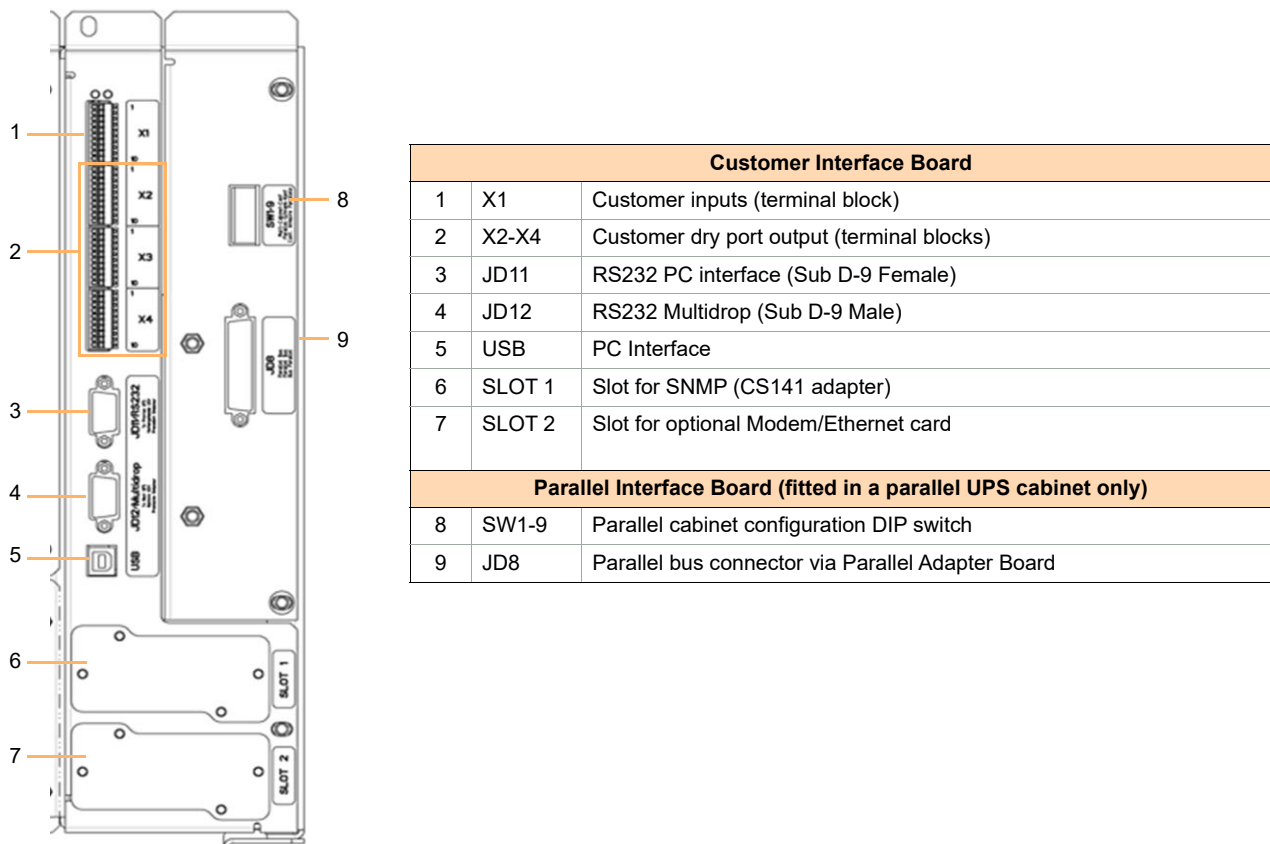


Figure 2.12 UPS Interface Boards

Two interface boards are fitted in the lower right-hand side of the UPS cabinet, adjacent to the UPS power switches. One is the Customer Interface Board and the other is the Parallel Interface Board.



Key Point: The Parallel Interface Board is part of the factory-fitted 'paralleling kit' and is installed only in UPS cabinets used in a parallel system.

2.5.1 Customer Interface Board

The customer interface board provides a number of input/output connections that can be used by the customer to interface the UPS cabinet with a range of external monitoring and control systems – e.g. as part as a building management system (BMS). The available interfaces are shown in Figure 2.12:

The dry-port I/O connection details are shown in the Installation chapter of this manual (*see paragraph 3.6*).



Key Point: When the UPS cabinet is installed as part of a parallel system the customer interface board I/O is disabled in the 'slave' cabinets if the system 'Multidrop' application is enabled.

Multidrop

The optional 'Multidrop' feature, which is available only in a parallel system, allows the customer interface board in the 'master' cabinet to collect data/messages from the other system cabinets. The received data is then processed at a centralised point on the 'master' customer interface board and made available to the user directly on the RS232 port (JD1). It is also transmitted to the CS141 card if inserted in the relevant slot.

This facility requires a purpose designed 'Multidrop' cable to be connected between each module's customer interface board JD12.

Note that when the multidrop feature is used, the I/O facilities of customer interface board in the 'slave' cabinets are all disabled, but the customer interface board fitted to the 'master' cabinet remains fully functional.

2.5.2 Parallel Interface Board

The parallel interface board facilitates the connection of the parallel control bus cables between the cabinets in a parallel cabinet system. These cables are connected to a 'Parallel Adapter' board which is fitted to JD8.

2.6 Module control panel

A door-mounted module control panel is provided for each UPS module. The control panel is used to start and stop the module, command a load transfer between inverter and bypass, and monitor the module's operating parameters. It is also used to configure and interrogate the module during commissioning and troubleshooting.

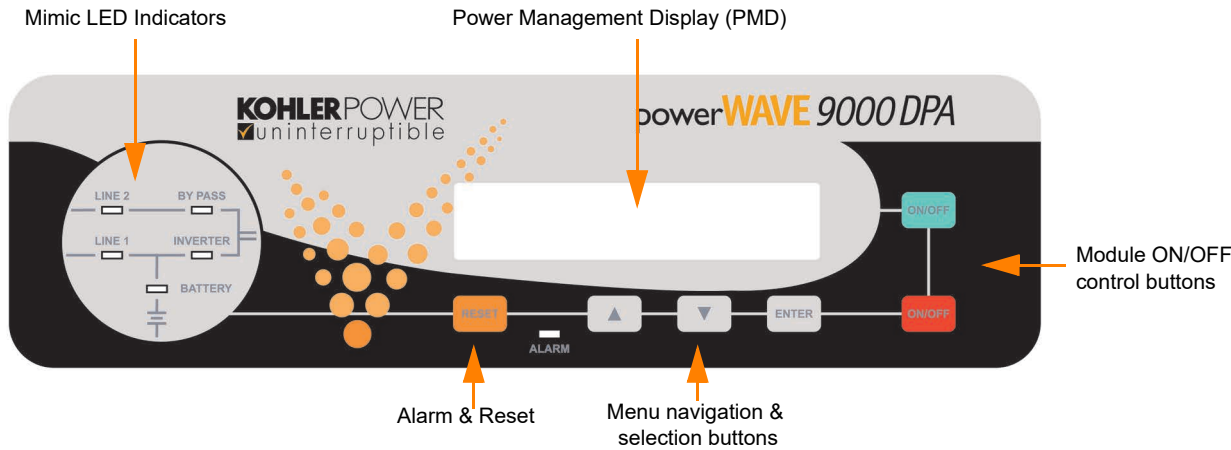


Figure 2.13 Module control panel

2.6.1 Module control panel buttons

The module control panel buttons allow you to:

- Start-up and shut down the UPS and transfer the load between inverter and bypass.
- Monitor and display the UPS operating voltages, currents, frequencies and other values on the LCD display.
- Reset/cancel an alarm.

Button function summary

BUTTON	FUNCTION
ON/OFF	Used to switch-on or switch-off the UPS by pressing both buttons simultaneously
UP (▲)	Scroll upwards through a displayed menu
DOWN (▼)	Scroll downwards through a displayed menu
ENTER	Selects a chosen menu item
RESET	Cancels an audible alarm. If the alarm condition is transient the ALARM LED will turn OFF, otherwise it will remain ON

ON/OFF Buttons

You can switch the UPS ON or OFF by simultaneously pressing both ON/OFF buttons (for less than 1s). The requirement to press both buttons is to help prevent accidental operation.

Pressing the two ON/OFF buttons during normal operation will immediately shut down the UPS module.

- In a single module system (e.g. DPA-50) this disconnects the UPS from the load unless the load is first transferred to the maintenance bypass.
- In a parallel module system the UPS module shuts down and is disconnected from the load: however the load may or may-not transfer to the static bypass, depending on whether or not the number of remaining on-line UPS modules satisfies the system's redundancy – i.e. if there is a sufficient number of modules remaining to support the system's load then the load is not transferred.

Note: To shut down all the UPS modules in a parallel system you must press both ON/OFF buttons on every module.

2.6.2 Module mimic LEDs

The mimic diagram LEDs indicate the general power flow through the UPS module and changes colour between Green and Red (and OFF) to indicate the prevailing UPS module operating conditions.

LED Indication summary

INDICATOR	INDICATOR STATUS	INTERPRETATION
LINE 1	GREEN RED OFF	Input (rectifier) mains available Input (rectifier) mains unavailable No bypass supply (UPS Turned off)
LINE 2	GREEN RED OFF	Bypass mains available (bypass OK) Bypass mains unavailable (bypass supply error) No bypass supply (UPS Turned off)
ALARM*	OFF Flashing RED + buzzer RED	No alarm condition Alarm condition Alarm condition present (audio has been reset)
INVERTER	GREEN RED OFF	Load on inverter Inverter fault or load transfer to inverter inhibited Inverter not operating (switched off)
BY-PASS	GREEN OFF	Load on bypass (or in ECO mode) Bypass not operating (turned off)
BATTERY	GREEN RED Flashing GREEN	Battery OK Battery faulty or discharged Battery on load (discharging) or battery fuse open

** The ALARM LED is a visual indication of an internal or external alarm condition. When activated, it is accompanied by an audible warning which can be cancelled by pressing the RESET button.*

2.6.3 Power Management Display (PMD)

A 2 x 20 character LCD Display simplifies communication with the UPS module and provides monitoring information.

The menu driven LCD provides:

- access to an 'event' register
- input and output voltage, current, frequency & power monitoring
- battery run time monitoring
- access to commands such as module load transfer between INVERTER and BYPASS
- access to the module's diagnostics registers (service mode only)
- access to module adjustments and testing (service mode only)

Status screens

DESCRIPTION	LCD-DISPLAY
1. Load is protected and being supplied by UPS inverter (Normal Operation).	LOAD PROTECTED 01
2. Load is not protected by UPS. It is either connected to the bypass (load on bypass) or connected to the inverter but with a battery problem.	LOAD NOT PROTECTED 01
3. Load supply completely powered-down. UPS has been switched off by "ON/OFF" buttons.	LOAD OFF SUPPLY FAILURE 01
4. UPS/module is not supplying load. The UPS output switch is open.	LOAD DISCONNECTED PARALLEL SWITCH OPEN 01

The two-digit number on the right hand side of the LCD indicates the power module ID number (see Figure 2.8).

DESCRIPTION	LCD-DISPLAY
1. Single Systems.	SYSTEM CONFIGURATION SINGLE S
2. Parallel System – e.g. DPA-250 bottom module in cabinet 2:	SYSTEM CONFIGURATION PARALLEL P06
3. Parallel System – e.g. DPA-250 top module in cabinet 3:	LOAD OFF SUPPLY FAILURE P15

Main menu screen

DESCRIPTION	LCD-DISPLAY
1. Provides access to a log of the last 64 stored events.	→ EVENT LOG MEASUREMENTS
2. Provides access to voltages, power, frequencies, currents, autonomy monitor screens.	→ MEASUREMENTS COMMANDS
3. Provides access to the 'Load to inverter', 'Load to bypass' and 'battery test' commands.	→ COMMANDS UPS DATA
4. Allows personalised UPS data (such as serial number) to be entered.	→ UPS DATA SET-UP USER
5. Allows the user to set up Date/Time, automatic battery test, etc.	→ SET-UP USER SET-UP SERVICE
6. This is a password-protected area for service engineer use only.	→ SET-UP SERVICE

Event log menu screen

DESCRIPTION	LCD-DISPLAY
1. Logging Control; a log of the last stored 64 events.	01 05-10-08 14-38-56 LOAD TO INV.
2. Every stored event is identified with a sequential number and time stamp.	02 05-10-08 14-38-59 LOAD TO BYP.
3. By pressing ENTER the code of the event will be displayed.	03 05-10-08 14-39-14 LOAD OFF

Measurements menu screen

DESCRIPTION	LCD-DISPLAY
1. Battery Runtime	BATT. RUN TIME (MIN) 00h 00mm
2. UPS-Output Frequency	OUTPUT FREQUENCY (HZ) 50.00
3. Bypass Frequency.	BYPASS FREQUENCY (HZ) 50.00
4. Battery Voltage	BATTERY VOLTAGE (V) +0.0 - 0.0
5. Battery Charger Current	BATT. CHARGE CUR. (A) + 0.0 - 0.0
6. Battery Discharge Current.	DISCHARGE CURRENT (A) 00.00
7. Rectifier Voltage (all three phases)	RECTIFIER VOLTAGE (V) 00.00 00.00 00.00
8. Bypass Voltage (all three phases)	BYPASS VOLTAGE (V) 00.00 00.00 00.00
9. Output Voltage (all three phases)	OUTPUT VOLTAGE (V)0 0.00 00.00 00.00
10. Output Current (all three phases)	OUTPUT CURRENT (A)0 0.00 00.00 00.00
11. Active Output Power (all three phases)	ACTIVE POWER (KW) 00.00 00.00 00.00
12. Reactive Output Power (all three phases)	REACTIVE POWER (kVar) 00.00 00.00 00.00
13. Apparent Output Power (all three phases)	APPARENT POWER (KVA) 00.00 00.00 00.00
14. Output Power (all three phases)	OUTPUT POWER (%) 00.00 00.00 00.00
15. Battery capacity	BATT. CAPACITY (%) 00.00

Commands menu screen

DESCRIPTION	LCD-DISPLAY
1. Transfer Load to inverter	→ LOAD TO INVERTER LOAD TO BYPASS
2. Transfer Load to bypass.	→ LOAD TO BYPASS PERFORM BATT. TEST
3. Battery Test	→ PERFORM BATT. TEST

UPS Data menu screen

DESCRIPTION	LCD-DISPLAY
1. These general UPS Data are installed at the manufacturing plant.	UPS SERIAL NUMBER nn-nnnnnn
2. Manufacturing date	DATE OF MANUFACTURE 15-03-16
3. EPROM Version	EPROM VERSION V-000
4. Actual Date and Time	DATE TIME dd-mm-yyyy hh:mm:ss

Set-up User menu screen

DESCRIPTION	LCD-DISPLAY
1. Set-up language	→ SET LANGUAGE SET DATE AND TIME ENGLISH FRANCAIS POLISH
2. Set-up Date and Time	→ SET-UP DATE/TIME SET-UP BATT. TEST DD-MM-YY HH-MM-SS
3. Set-up battery test	→ SET-UP BATT. TEST SET-UP GEN-SET OPER. DAY OF MONTH (1-31) HOUR OF DAY (0-23) REPETITIVE (Y/N) 000
4. Set-up operation with Gen-Set	→ SET GENERATOR OP. BATT. CHARGE LOCK (Y/N) BYPASS LOCK (Y/N)

Set-Up Service menu screen


Key Point: This area is password protected and access is restricted to approved Service Engineers only.

2.7 Warranty

The PowerWAVE 9000DPA UPS is supplied with a limited warranty that the UPS and its component parts are free from defects in materials and workmanship for a period of one year from the date of original commissioning, or fifteen months from the date of original delivery, whichever is the sooner. This warranty is the only warranty given and no other warranty, express or implied, is provided.

This warranty is invalidated if the UPS is used without having first been commissioned by a fully trained and authorised person. This warranty does not apply to any losses or damages caused by misuse, abuse, negligence, neglect, unauthorised repair or modification, incorrect installation, inappropriate environment, accident, act of God or inappropriate application.

If the UPS fails to conform to the above within the warranty period then Kohler Uninterruptible Power Ltd. will, at its sole option, repair or replace the UPS. All repaired or replaced parts will remain the property of Kohler Uninterruptible Power Ltd.

As a general policy, Kohler Uninterruptible Power Ltd. does not recommend the use of any of its products in life support applications where failure or malfunction of the product can be reasonably expected to cause failure of the life support device or to significantly affect its safety or effectiveness. Kohler Uninterruptible Power Ltd. does not recommend the use of any of its products in direct patient care. Kohler Uninterruptible Power Ltd. will not knowingly sell its products for use in such applications unless it receives in writing assurances satisfactory to Kohler Uninterruptible Power Ltd. that the risks of injury or damage have been minimized, the customer assumes all such risks and the liability of Kohler Uninterruptible Power Ltd. is adequately protected under the circumstances



CAUTION: The UPS system may contain batteries which must be re-charged for a minimum of 24 hours every six months to prevent deep-discharging. Batteries that have been, for whatever reason, deeply-discharged are not covered by the warranty.

2.8 Extended Warranty

The Standard Warranty may be enhanced by protecting the UPS with an Extended Warranty Agreement (maintenance contract). An Extended Warranty Agreement enhances the standard warranty by providing:

- Regular preventative maintenance inspections
- Guaranteed speed of response to operational problems
- 24 hour telephone support
- Fully comprehensive (excluding batteries) cover

Contact the Service Support Hotline on 0800 731 3269 (24Hr.) for further details

2.9 Additional Service/Maintenance Support

If you are interested in obtaining an extended warranty for your PowerWAVE 9000DPA, or require service/maintenance support for any other UPS you may have, please contact Kohler Uninterruptible Power Ltd. at the following address:

Kohler Uninterruptible Power Ltd.
Woodgate
Bartley Wood Business Park
Hook
Hampshire, United Kingdom
RG27 9XA

Tel: +44 (0)1256 386700
0800 731 3269 (24Hr.)

Email: ukservicesales.ups@kohler.com

3 Installation

3.1 Introduction

This chapter contains essential information concerning the unpacking, installation planning and cabling of the PowerWAVE 9000DPA UPS system.



Key Point: If you are installing an external battery cabinet supplied by Kohler Uninterruptible Power Ltd. you should refer to the manual that is provided with the cabinet for installation instructions.



WARNING: All the operations described in this chapter must be supervised by suitably qualified personnel and all aspects of the electrical installation must be carried out by an authorised electrician.

Kohler Uninterruptible Power Ltd. will take no responsibility for any personal injury or material damage caused by incorrect cabling or operation, or activities which are not carried out in strict accordance with the instructions contained in this manual.



WARNING: Once the UPS equipment is installed it must be commissioned by an engineer approved by Kohler Uninterruptible Power Ltd., or one of its service agents, before it is powered-up. Kohler Uninterruptible Power Ltd. will take no responsibility for any personal injury or material damage caused by the application of electrical power to this equipment before it has been fully commissioned.

3.2 Taking receipt of the UPS

The UPS and accessories are delivered on a purpose-designed pallet that is easy to move with a forklift or a pallet jack.



CAUTION: Observe the following precautions when off-loading and moving the UPS:

- Always keep the packages in an upright position.
- Do not drop the equipment.
- Do not stack the pallets.

Depending on the method of shipping, the UPS is packed in a cardboard or wooden container designed to protect it from mechanical and environmental damage. Further protection is provided by wrapping the equipment with a plastic sheet.

Before you accept the shipment ensure that the received package(s) correspond to the description shown in the delivery documentation. Note that some ordered optional equipment packages might be shipped inside the UPS cabinet.

Carefully examine the packing container for signs of physical damage. The external 'Tip&Tel' ("FRAGILE" and "ARROW") indicators should be intact if the equipment has been transported in an upright position.

3.2.1 Reporting transportation damage



WARNING: If the Tip&Tell indicators indicate that the UPS has been tilted in transit DO NOT connect the UPS to the mains electricity supply.

If the 'Tip&Tel' indicators are ruptured or there are other signs of suspected transportation damage you must inform the carrier and Kohler Uninterruptible Power Ltd. immediately.

Other claims for shipping damage must be filed immediately when found, and the carrier must be informed of ALL claims within seven days of receipt of the equipment. If the equipment is to be stored for longer than seven days before it is installed, you should unpack it and inspect it for signs of internal damage before you put it into storage. Note that some optional equipment packages might be shipped inside the UPS cabinet and these too should be checked for damage.

If the equipment is damaged you should store the packing materials for further investigation

3.2.2 Weight and dimensions

Packed weight and dimensions

Model	Number of Modules	30kVA Modules w/o Batt (kg.)	40kVA Modules w/o Batt (kg.)	50kVA Modules w/o Batt (kg.)	Packed Dimensions
UPS Module		43.1	45.3	46.8	WxHxD
DPA 50	1	328	330	332	890 x 1800 x 920
DPA150	1	307	309	311	890 x 2120 x 920
	2	350	355	358	890 x 2120 x 920
	3	393	400	404	890 x 2120 x 920
DPA250	1	273	275	277	890 x 2120 x 920
	2	316	321	324	890 x 2120 x 920
	3	359	366	370	890 x 2120 x 920
	4	402	411	417	890 x 2120 x 920
	5	446	457	464	890 x 2120 x 920

Unpacked weight and dimensions

Model	Number of Modules.	30kVA Modules w/o Batt (kg.)	40kVA Modules w/o Batt (kg.)	50kVA Modules w/o Batt (kg.)	Unpacked Dimensions
Module		43.1	45.3	46.8	WxHxD
DPA 50	1	305	307	309	730 x 1650 x 800
DPA150	1	282	284	286	730 x 1975 x 800
	2	325	330	333	730 x 1975 x 800
	3	368	375	379	730 x 1975 x 800
DPA250	1	248	250	252	730 x 1975 x 800
	2	291	296	299	730 x 1975 x 800
	3	334	341	345	730 x 1975 x 800
	4	377	386	392	730 x 1975 x 800
	5	421	432	439	730 x 1975 x 800

3.2.3 Local transportation

When you transport the UPS equipment after it has been off-loaded please observe the following precautions.



CAUTION: Local transportation:

- When moving the UPS cabinet using a forklift or pallet jack, insert the lifting equipment forks into the front and rear shipping brackets to lift the cabinet securely and prevent it from toppling over.
- Do not at any time tilt the cabinet by more than 10° from vertical.



WARNING: Potential dangers:

- If the equipment cabinet is tilted by more than 10° it could cause internal damage. If tilting occurs do not connect the UPS to the mains electrical supply.
- The weight cabinet can cause serious personal injury and/or structural damage to the surrounding area if dropped in transit. Always take extreme care when moving the equipment.

3.2.4 Storage

If you plan to store the UPS prior to its installation it should be kept (preferably in its shipping packaging) in a clean, dry environment with a temperature between -25°C to +70°C and RH <90%. If the storage period is likely to exceed seven days the packaging should be removed and the UPS inspected for shipping damage before it is placed into storage. If there is no apparent damage you should refit the packaging or cover the UPS with a dust-cover to prevent the ingress of dust and dirt.

Depending on the UPS model, the batteries can be housed within the UPS cabinet or an external battery cabinet/battery rack. In the case of internally-mounted batteries, the batteries can be shipped already installed within a cabinet. Batteries that are intended for external rack-mounting will be shipped in a separate package and should be stored under the environmental conditions stipulated above.

3.2.5 Unpacking



WARNING: The UPS cabinet, battery cabinet (optional) and battery packages are heavy and may tip during unpacking unless the unpacking instructions are not followed closely.

If the shipment is received in good order (i.e. the 'tip & tell' "FRAGILE" and "ARROW" indicators on the packing container are intact) then unpack the UPS as follows:

1. If the cabinet is shipped inside a wooden case, remove the screws at the base and sides of the case then carefully remove the case from the from the package.
2. Remove the plastic sheeting covering the UPS.
3. Remove the external cabinet protection pieces (strengthened cardboard fillets, polystyrene foam etc.).
4. Remove the anchor bolts securing the cabinet to the pallet then lift and remove the cabinet from the pallet.
5. Retain the packaging materials for future shipment of the UPS.
6. Examine the cabinet for any sign of damage and notify your supplier immediately if any damage is found.
7. Open the cabinet door and verify that the UPS rating specifications on the nameplate located inside the door match the order specification.
8. Remove any accessories packages that are shipped inside the cabinet.
9. Remove any internal protective packaging.
10. Ensure that all the UPS modules are correctly and securely fitted in their rack compartments.
11. Ensure that a protection cover is fitted to the front of any unpopulated UPS module rack compartment.

Batteries



CAUTION: The UPS batteries must ALWAYS be installed by the commissioning engineer.

If the batteries are shipped in a separate package they should remain in their packing until required by the Kohler Uninterruptible Power Ltd. service engineer when the system is commissioned.

Battery life depends very much on temperature, and optimum battery life will be obtained if the batteries are stored and operated at a temperature of 20°C.



WARNING: If the UPS is delivered without batteries, Kohler Uninterruptible Power Ltd. will not accept responsibility for any damage or malfunctioning caused to the UPS by the incorrect storage, installation or connection of batteries carried out by third parties.

3.3 Installation planning (environmental & mechanical)

3.3.1 Environmental considerations

A certain amount of pre-planning will help provide a trouble-free installation process. You should consider the following guidelines when planning a suitable UPS location and operating environment.

1. The route to the installation location must allow the equipment to be transported in an upright position.
2. The floor at the proposed installation site and en-route from the off-loading point must be able to safely support the weight of the UPS and battery equipment, plus fork lift or trolley jack during transit.
3. The UPS cabinet requires space to bottom/front, top and back to enable cooling airflow (see below).
4. A minimum clearance of 200mm must be provided at the back of the cabinet to provide adequate ventilation. A clearance of 400mm should also be provided at the top of the cabinet if the passage of cooling airflow at the back of the cabinet is insufficient to dissipate the generated heat – see figure 3.1.
5. All parts of the UPS required for maintenance, servicing and user operation are accessible from the front of the cabinet and require a minimum front clearance of 1000mm.

Note: The cabinet door must be opened by 115° in order to remove/fit the UPS modules, so the right-hand side of the cabinet cannot be positioned directly against a projecting wall – see figures 3.1.

6. A temperature of 20°C is necessary to achieve the recommended battery life span. The cooling air entering the UPS modules must not exceed +40°C.
7. The floor material should be non-flammable and strong enough to support the heavy load.
8. In summary, the UPS should be located where:
 - a) Humidity (< 90%) and temperature is ideally 20°C.
 - b) Fire protection standards are respected.
 - c) Cabling can be performed easily.
 - d) A minimum 1000mm front accessibility is available for service or periodic maintenance.
 - e) Adequate cooling air flow is available.
 - f) The air conditioning system can provide a sufficient amount of air cooling to keep the room at, or below, the maximum desired temperature.
 - g) No dust or corrosive/explosive gases are present.
 - h) The location is vibration free.
 - i) If the UPS will be installed in bayed enclosures, partition walls must be installed.

3.3.2 Clearances

Cooling air enters the front and bottom of the UPS cabinet and is extracted by ventilation fans mounted on the cabinet rear. If the UPS cabinet is installed immediately adjacent to another cabinet, battery enclosure or wall, a minimum clearance of 300mm is required at the rear of the cabinet to permit sufficient cooling air flow. This can be reduced to 200mm if the cabinet is installed as a stand-alone unit with at least 400mm combined side clearance (see Figure 3.1).

The UPS cabinet does not require any side clearance for ventilation or service access, so it can be installed immediately alongside other UPS cabinets or battery cabinets to form an equipment suite. If an external battery cabinet is used you should install it as close as possible to the UPS cabinet, ideally immediately adjacent to it.

If you install the recommended external battery cabinet or battery rack supplied by Kohler Uninterruptible Power Ltd. the battery cabinet itself does not require any side or rear clearance.

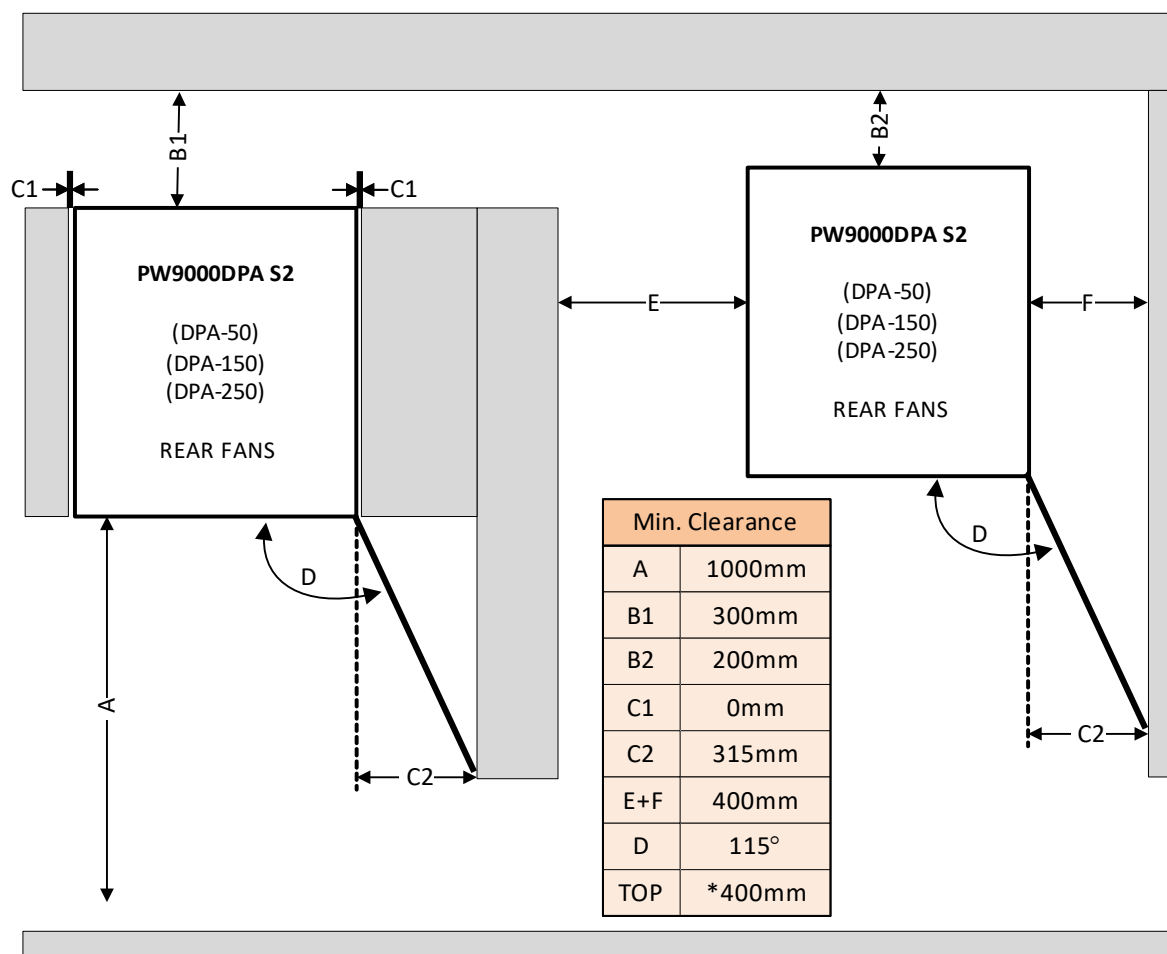
All UPS cabling, maintenance and servicing procedures can be carried out from the front of the cabinet, and a front clearance of at least 1000mm should be provided to enable component replacement.



Key Point: When installing the UPS cabinet next to an external battery cabinet or battery rack, the battery cabinet/rack might require more than 1000mm front clearance which must be taken into consideration when installing a cabinet suite.



Key Point: The UPS door must be fully opened (to approximately 115°) to enable some major component to be extracted from the cabinet. If the right side of the cabinet is positioned against a wall that protrudes in front of the cabinet you must allow adequate, additional side clearance. See the clearance diagrams above for details.



It is necessary to open the door fully to remove some internal assemblies during maintenance procedures. If the cabinet is placed against a wall ensure sufficient space is provided (C2).

If the cabinet is not positioned immediately adjacent to any other cabinet or battery enclosure, the clearance behind the unit can be reduced from 300mm (B1) to 200mm (B2) if the total combined side clearance (E+F) is at least 400mm.

*A TOP clearance of 400mm is only required if there is no other route at the rear of the UPS to dissipate the cooling air flow.

Figure 3.1 PW9000DPA S2 clearances

3.4 Installation planning (electrical)

3.4.1 General requirements

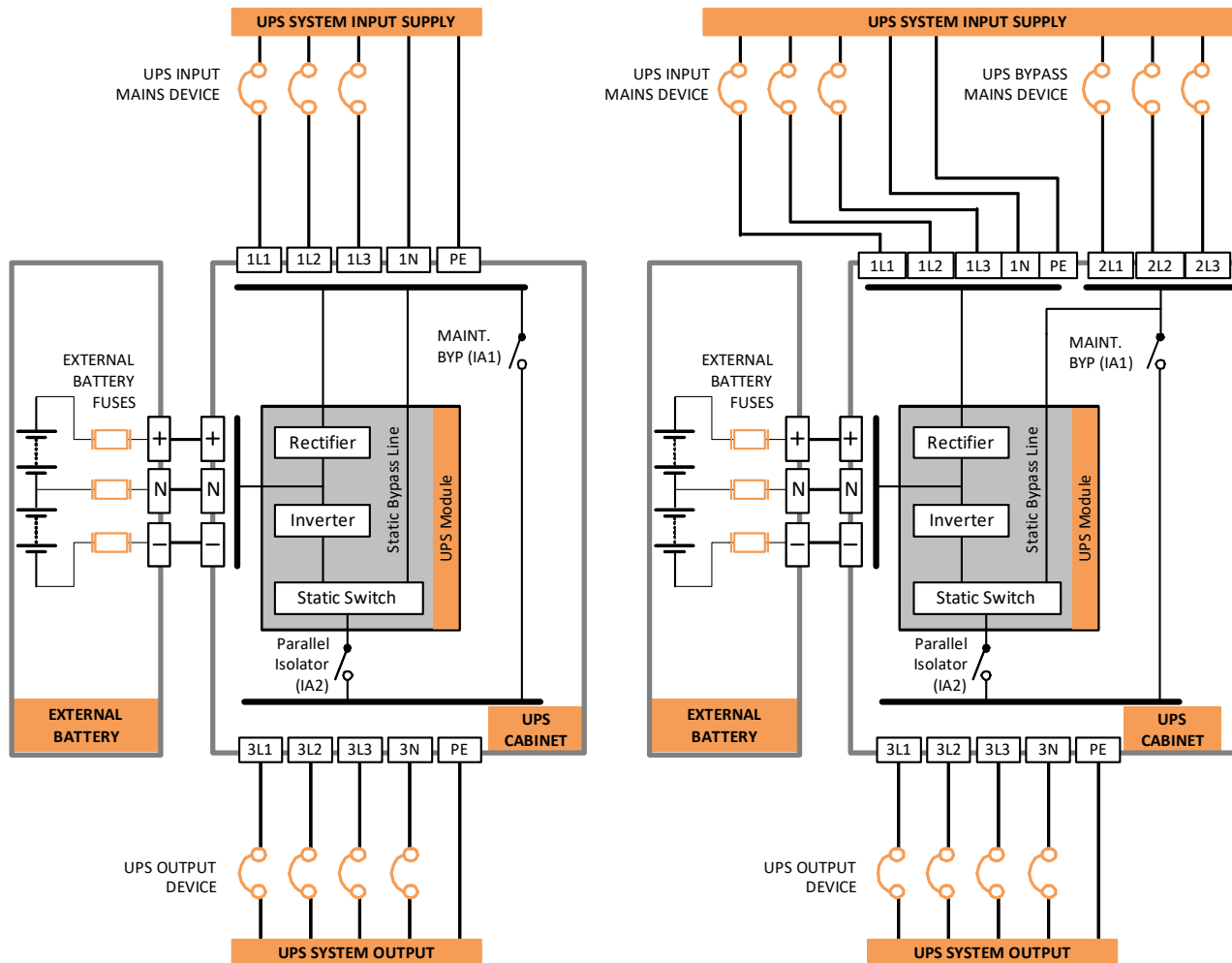


Figure 3.2 Input/output power connections for single feed and dual feed installations

It is the customer's responsibility to design and install the UPS supply and distribution circuits and provide the external fuses, isolators and cables required to connect the UPS input and output power supplies, and external battery (where used). The information provided in this section should assist in the planning and preparation of the UPS power cabling.

As shown in Figure 3.2, the UPS input mains and bypass mains inputs should be connected to the utility mains supply through an LV-switchgear panel and protected by a circuit breaker or fused isolator. These, not only provide overload protection for the UPS cabinet but also serve as the primary means of isolating the UPS from the mains supply as the UPS cabinet itself does not contain an internal mains isolator switch.

Similarly, the UPS output should be connected to the load equipment via a suitably fused load switchgear panel.

Figure 3.2 shows an external battery cabinet used with the DPA 250 (and DPA 50 or DPA150 if long autonomy times are required). Suitable battery isolators must be fitted inside the external battery cabinet. This requires a three-pole breaker, connected to the battery positive, negative, and mid-point (neutral), as shown. Kohler Uninterruptible Power Ltd. can supply a matching battery cabinet containing the necessary fuses and switchgear.

Single feed / dual feed inputs

The UPS input mains and bypass mains terminals can be linked inside the UPS cabinet in what is known as a 'single feed' configuration. This configuration, which is used in the majority of installations, only requires one mains supply as illustrated in the left illustration of Figure 3.2.

When the 'single feed' links are removed, the bypass mains terminals must be connected to a mains supply source via a dedicated bypass mains supply circuit breaker (or fuses). A 'dual feed' configured module is shown in the right illustration of Figure 3.2.

Cabling a parallel cabinet system

In a parallel cabinet installation all the UPS cabinets must be supplied from the same mains power source and the cables from the mains switchgear panel to each cabinet should be of equal length. Similarly, the UPS output cables connected to the load switchgear panel should be of equal length (see Figure 3.3) – this helps to balance the load sharing between the UPS cabinets.

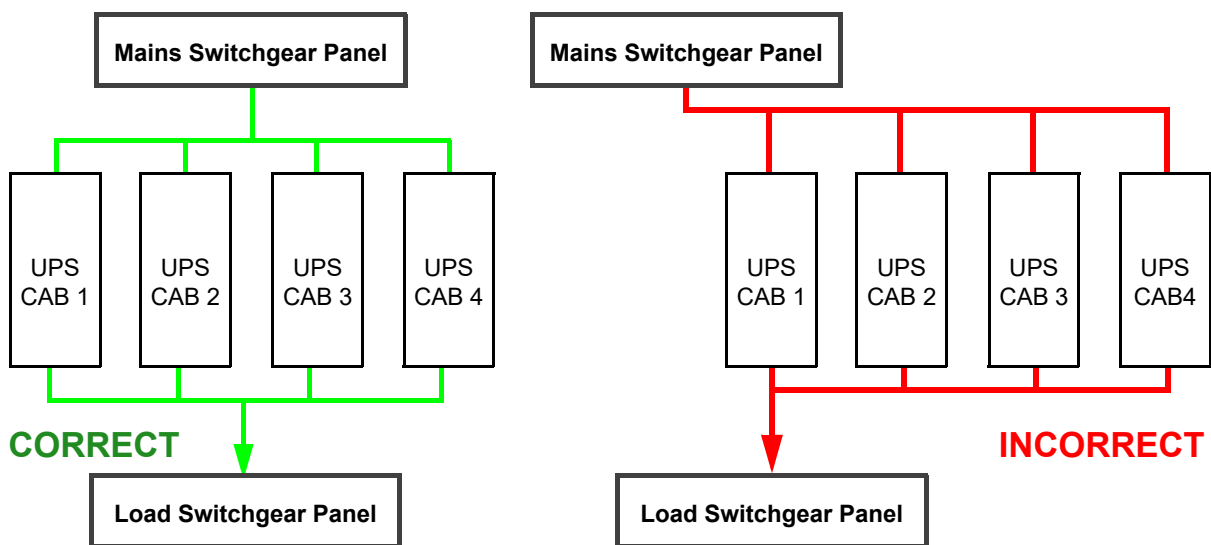


Figure 3.3 UPS Cabinet parallel power cabling considerations

Input neutral grounding

The input neutral must be permanently connected (unswitched) and grounded. This is necessary to enable the rectifier to operate correctly and allow the UPS to function properly when operating on battery.

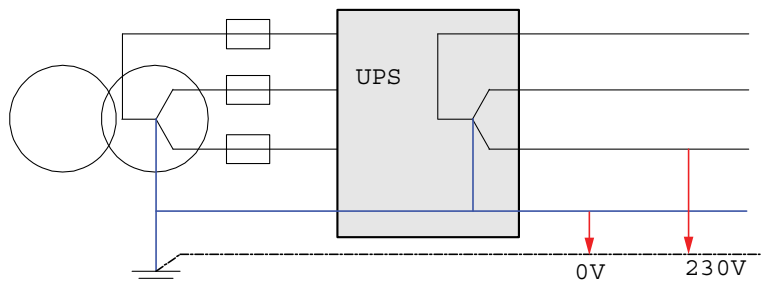


Figure 3.4 permanent, grounded input neutral



Key Point: As the input neutral must be unswitched and connected to the UPS at all times, DO NOT use a 4-pole input switch or isolator at the LV Distribution panel on a TN-S system.

3.4.2 External maintenance bypass switches

An external maintenance bypass is a required part of a multi-cabinet system but is optional in the case of a single cabinet installation.

The external bypass is bespoke to the installation but generally comprises three switches rated to carry the full system load and connected in a similar fashion to that shown in Figure 3.5.

The switches may be installed in a dedicated external Maintenance Bypass switch cabinet or included in an existing (or dedicated) switchgear panel. Kohler Uninterruptible Power Ltd. can supply a range of external maintenance bypass solutions to suit all of its UPS systems.

Note: When starting a UPS system we strongly advise that the load is initially turned on while the system is operating via the maintenance bypass in order to handle any large inrush currents that might occur.

Single UPS cabinet installation

An external maintenance bypass facility is not essential as part of a single cabinet installation as the internal maintenance bypass switch (IA1) is fully rated for the cabinet and can be used to connect the load directly to the UPS bypass mains supply. However, when the system is operating via the internal maintenance bypass (IA1) the UPS input/bypass mains supply must be permanently available, so it is not possible to isolate these supplies from the cabinet (or UPS modules) while the internal maintenance bypass is in use.

This situation is overcome by the addition of an external maintenance bypass circuit, similar to that shown in Figure 3.5, which can supply the load through the external BYPASS switch while allowing the UPS cabinet input and output power to be totally isolated by opening the external INPUT and OUTPUT switches.

Parallel UPS cabinet installation

When two (or more) UPS cabinets are connected as a parallel system each one still contains the internal maintenance bypass switch (IA1); however, this switch is only rated at the specified cabinet output and is not designed to switch the potential full system load.

An external maintenance bypass facility is therefore an essential part of a parallel cabinet system as the external bypass switch is rated for the full 'system' load and thereby it allows the full load to be switched between the UPS system and maintenance bypass. It also allows the cabinets' input and output power lines to be totally isolated.

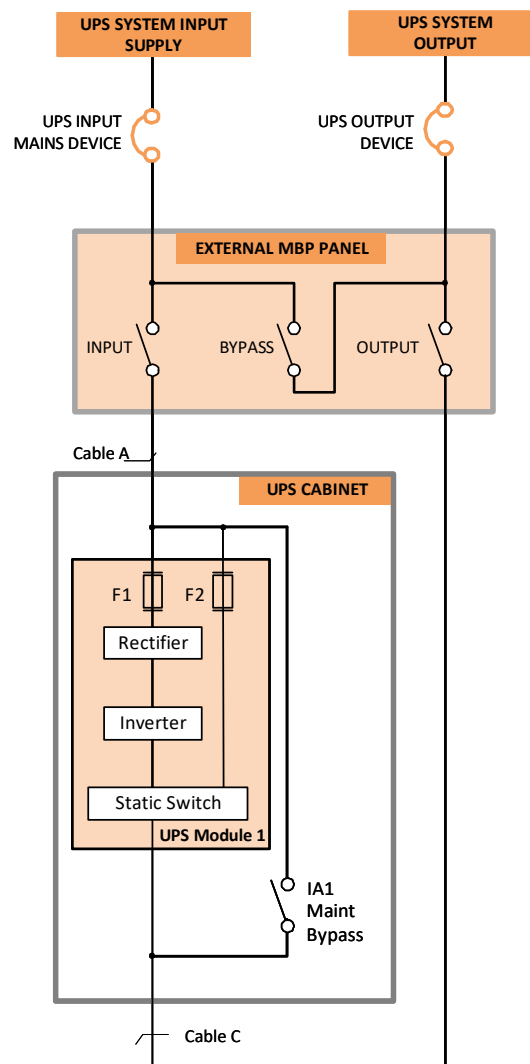


Figure 3.5 External Maintenance Bypass



Key Point: When operating a parallel cabinet system ALWAYS use the external maintenance bypass facility. Do not operate the internal maintenance bypass switch (IA1).

3.4.3 Cable sizing

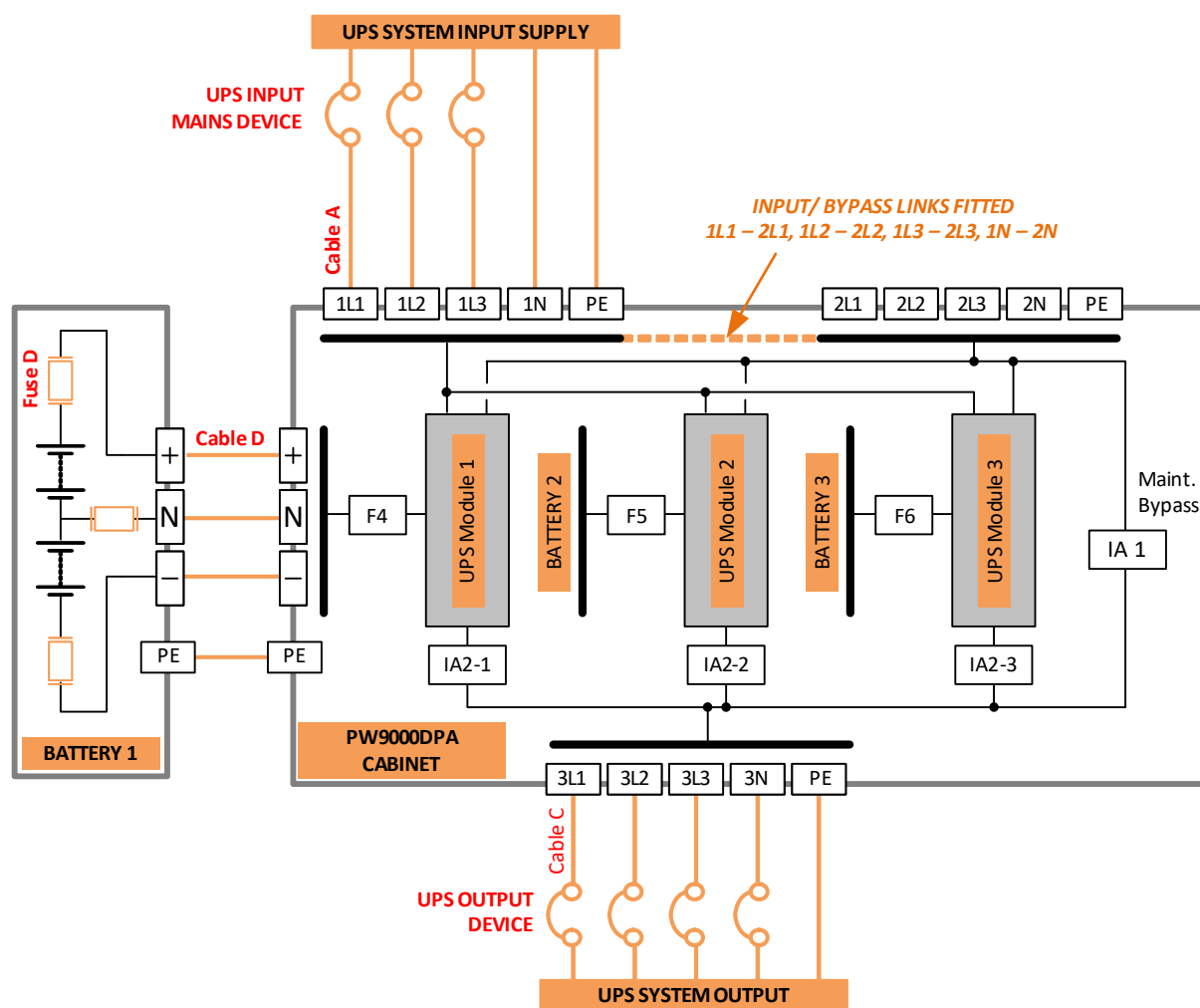


Figure 3.6 'Single feed' input block diagram

Figures 3.6 and 3.7 identify (in red) the power cables, fuses and other protective devices that must be provided by the customer for a single-feed and dual-feed connected installation respectively. The table below shows the maximum UPS input and output current for each set of cables together with the cable termination details. This is provided to assist the customer in selecting appropriately rated power cables and external switchgear.

Note: These illustrations show connections to an external battery cabinet, which is used by the DPA-250 (and DPA 50 or DPA250 if long autonomy times are required). Standard DPA-50 and DPA-150 models contain internal batteries complete with a fused battery isolator for each fitted power module. The internal battery cables are supplied with the cabinet.

Where external batteries are used, the DC cables and battery fuses are bespoke to the installation and must be rated accordingly.



Key Point: This information is given for guidance only. All fuses, isolators and power cables must be rated and installed in accordance with the prescribed IEC standards or local regulations – e.g. BS7671.

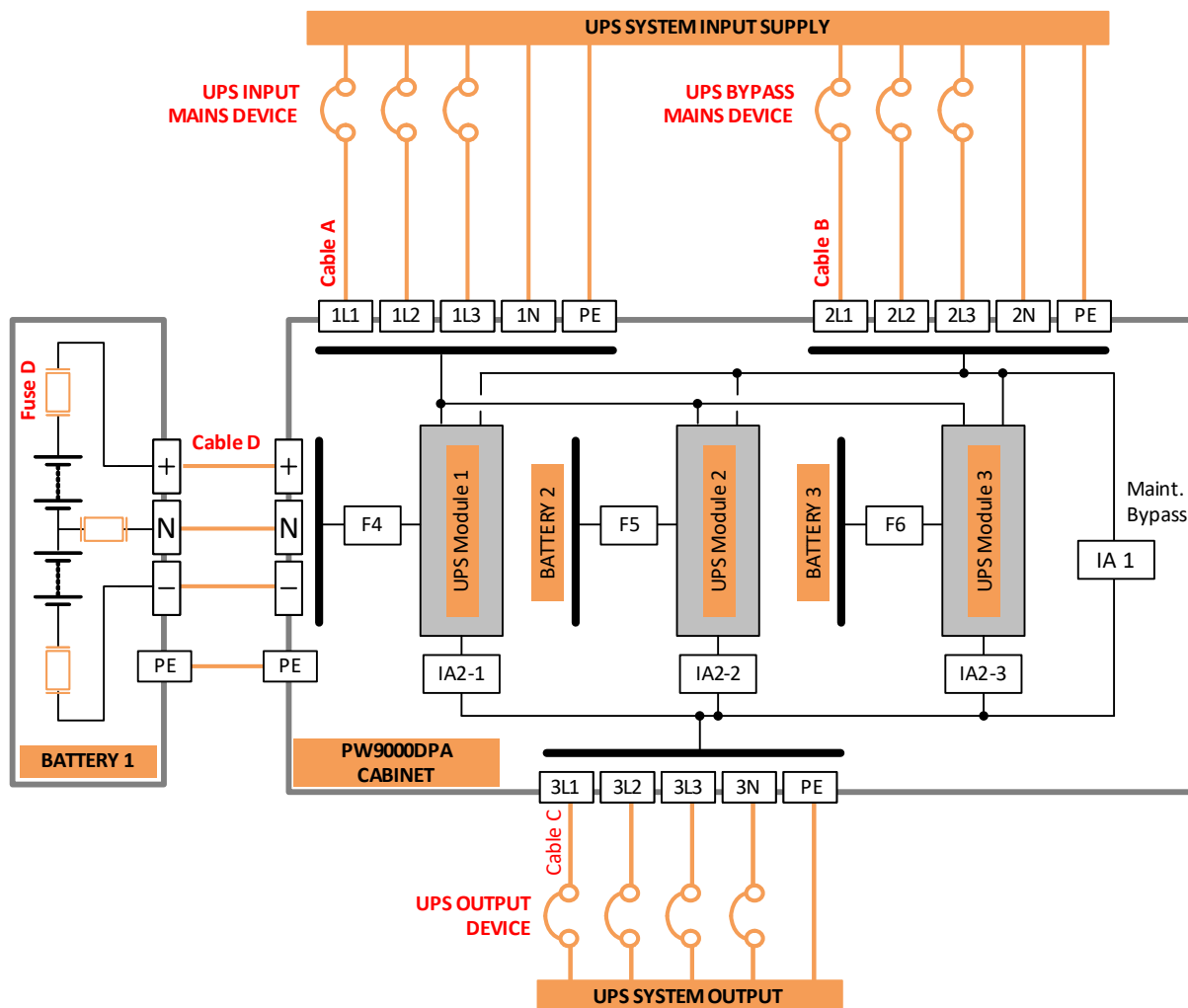


Figure 3.7 'Dual feed' input block diagram

MODEL	400V / 230V						BATTERY		
	INPUT MAINS (A)		BYPASS MAINS (B)		UPS OUTPUT (C)		PE	+ and -	N
	Max. Current	Terminal	Max. Current	Terminal	Max. Current	Terminal	Terminal	Terminal	Terminal
DPA-50	67A	5 x 16/25mm ² (T)	67A	4 x 16/25mm ² (T)	72A	5 x 16/25mm ² (T)	4 x 16/25mm ² (T)		
DPA-150	202A	4 x M10 (B) +PE 1xM10 (B)	202A	3 x M10(B) +PE 1xM10 (B)	218A	4 x M10 (B) +PE 1xM10 (B)	10 x 16/25mm ² (T) + 1xM10(B) Ind. Batts 4 x M10 (B) Common battery		
DPA-250	337A	4 x M12 (B) +PE 1xM12 (B)	337A	3 x M12 (B) +PE 1xM12 (B)	362A	4 x M12 (B) +PE 1xM12 (B)	15 x 16/25mm ² (T) + 1 x M12 (B) Ind Batts 4 x M12 (B) Common battery		

(PE) = Protective Earth


(N) = Neutral

(B) = Busbar connections with indicated bolt size. Cable must be terminated with a suitable lug.

(T) = Screwed terminal block with indicated maximum cable c.s.a. Cable ends must be suitably prepared.

3.4.4 UPS Power connections

Figures 3.8 and 3.9 illustrate the UPS cabinet power terminal connections. The DPA-150 and DPA-250 cabinet diagrams show the optional common battery links fitted so that the battery is connected to all the fitted power modules. If the installation is to include separate batteries see paragraph 3.4.5 and figures 3.10 to 3.12 for cabling details.

 **Key Point:** In a redundant module system the overall system reliability is increased by using an individual battery string for each UPS module as this extends the module redundancy to include the battery – i.e. if one battery fails it only affects one UPS module.

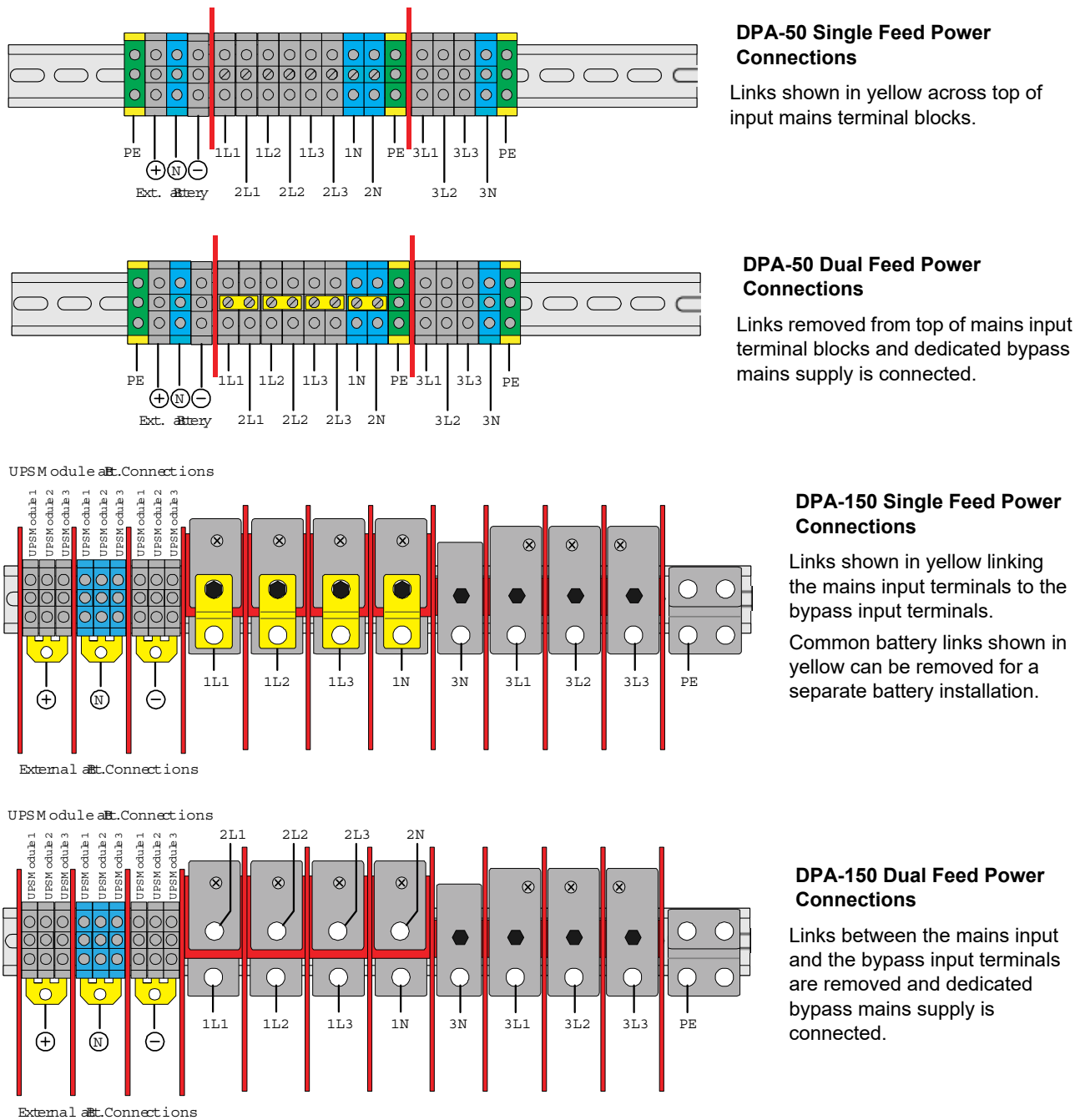
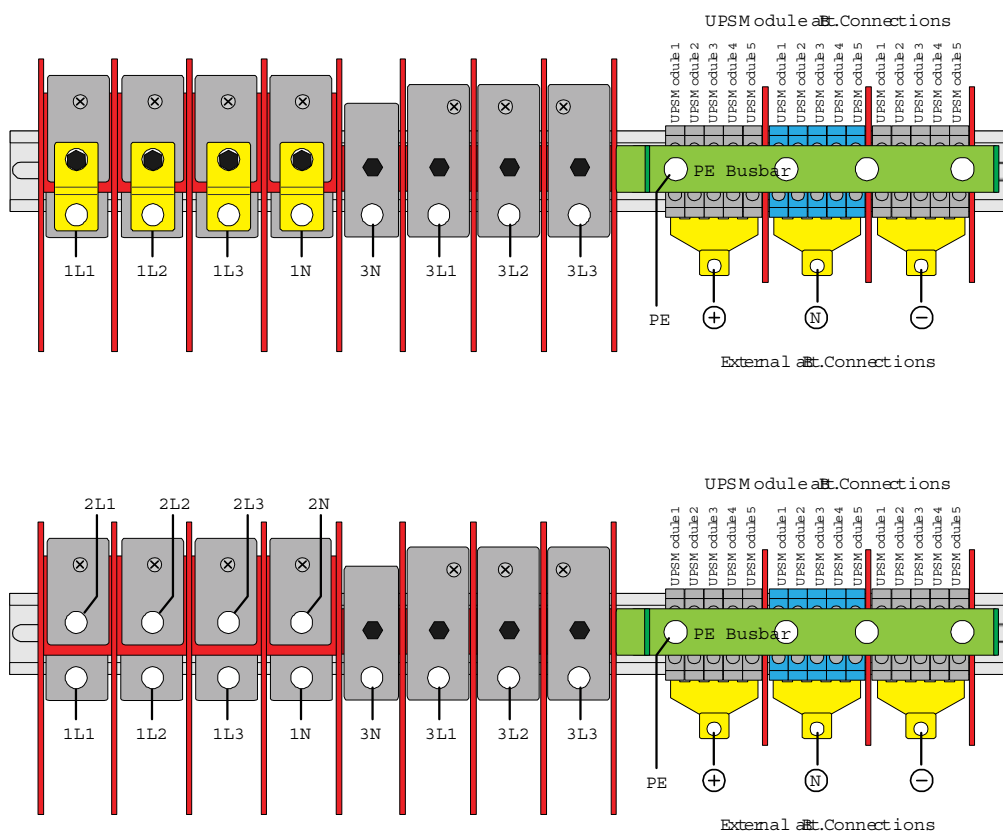


Figure 3.8 DPA-50 and DPA-150 cabinet power connections



DPA-250 Single Feed Power Connections

Links shown in yellow linking the mains input terminals to the bypass input terminals.

Common battery links shown in yellow can be removed for a separate battery installation.

DPA-250 Single Feed Power Connections

Links shown in yellow linking the mains input terminals to the bypass input terminals.

Common battery links shown in yellow can be removed for a separate battery installation.

Figure 3.9 DPA-250 Power connections

3.4.5 Battery configuration

IMPORTANT NOTE

High voltage battery strings can be extremely dangerous and should not be installed by the customer's installation team. All batteries must be fitted and connected to the UPS by a Kohler Uninterruptible Power Ltd. service engineer.

It is, however, the customer's responsibility to provide appropriate containment for the DC power cables that will be connected between the UPS cabinet and external battery installation where necessary – e.g. cable trays or trunking.

The battery configuration and cabling details shown below are provided for reference only.

The UPS battery comprises a number of sealed 12V battery blocks that are mounted either within the UPS cabinet (DPA-50 & DPA-150) or enclosed in an external battery cabinet or rack (DPA-250). An external battery system can also be used in conjunction with the DPA-50 or DPA-150 to increase the battery autonomy time if required.



Key Point: If you are installing an external battery cabinet supplied by Kohler Uninterruptible Power Ltd. you should refer to the manual that is supplied with the cabinet for installation instructions.

Each UPS module must be connected to between 42-50 12V battery blocks that are connected in series to form a battery string of the required voltage and capacity. Within the UPS cabinet the battery string is connected to three power terminals annotated '+' '-' and 'N'. The plus and minus terminals are connected to the battery string positive and negative extremities, and the 'N' terminal is connected to a point exactly mid-way along the battery string. For this reason the battery string must comprise an even number of blocks.

Two battery configurations are possible – i.e. 'common battery' and 'separate battery'. Figure 3.10 shows the connections for both configurations using the internal batteries in a DPA-150 cabinet fitted with three UPS modules.

Figures 3.11 and 3.12 show an example of the battery connections when using an external battery system and illustrates a DPA-250 cabinet with five fitted UPS modules.

Common battery

All the power modules are connected to a single battery source (although that source may itself comprise several battery strings connected in parallel). This requires 'common battery' links to be fitted to the UPS battery terminal blocks, as shown.

Separate battery

Each UPS module is connected to an individual battery string.

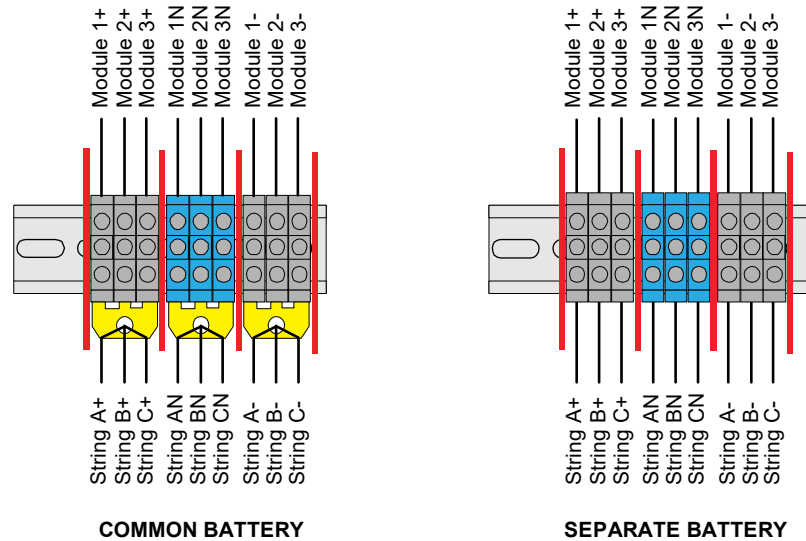
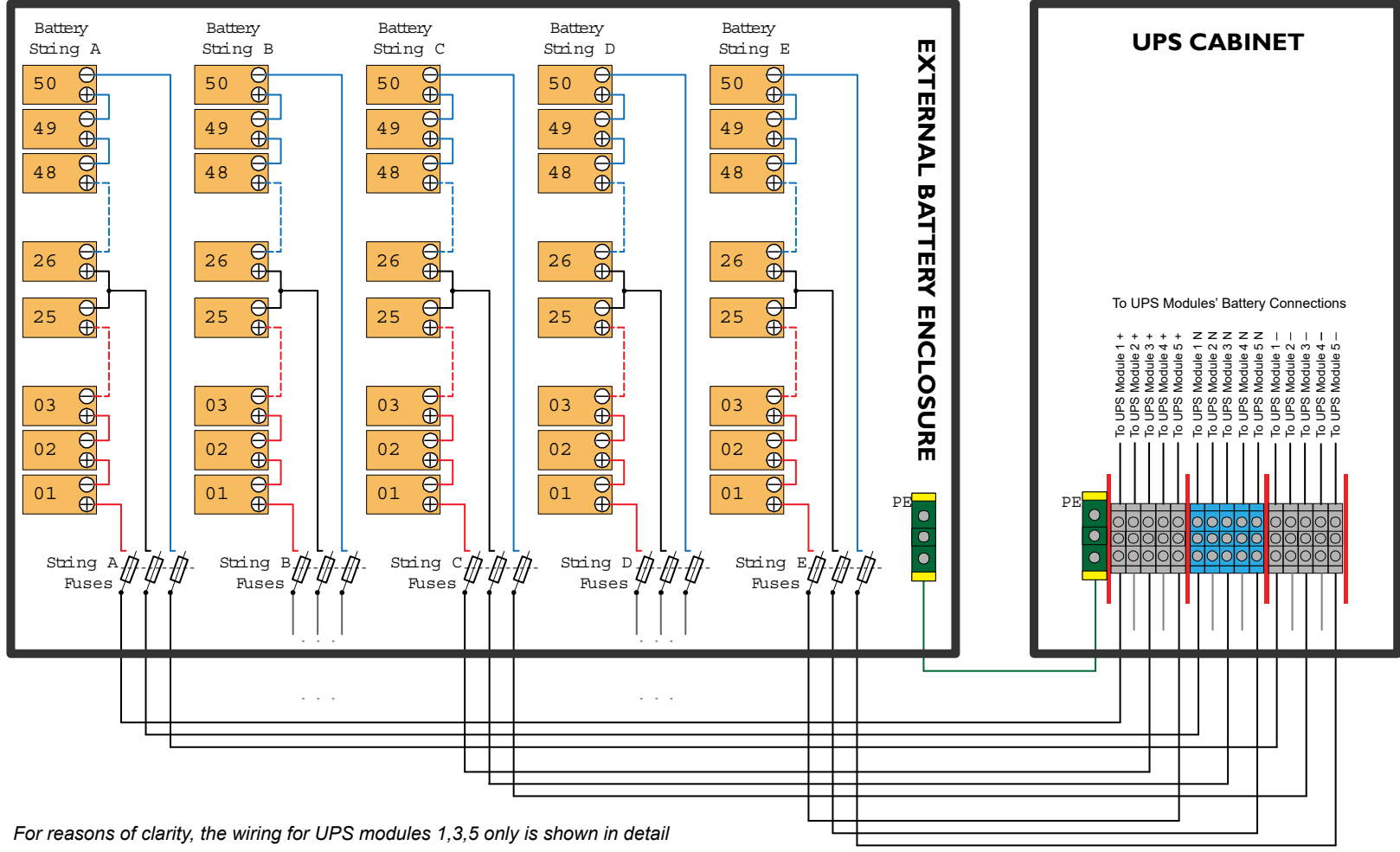


Figure 3.10 Internal battery connections (DPA-50 / DPA-150)



Key Point: If you are installing an external battery cabinet that is not supplied by Kohler Uninterruptible Power Ltd. you should refer to the manufacturer's installation manual to ensure that it contains a suitable number connections and isolators to provide five individual battery strings.

3.4.6 External battery enclosure with separate battery configuration



For reasons of clarity, the wiring for UPS modules 1,3,5 only is shown in detail

Figure 3.11 Wiring details for external separate battery configuration

3.4.7 External battery enclosure with common battery configuration

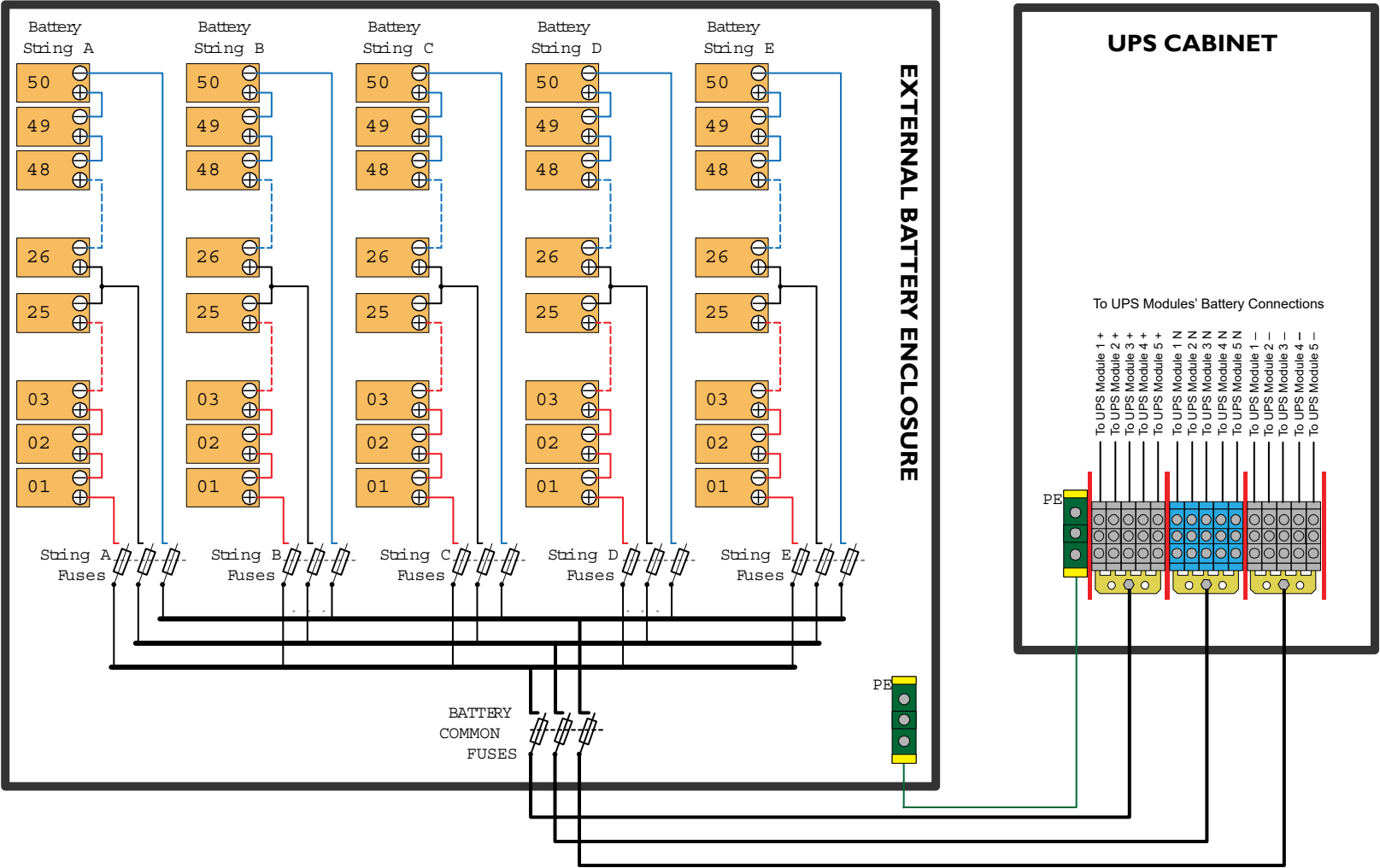


Figure 3.12 Wiring details for external common battery configuration

3.5 UPS Cabling procedure



WARNING: If you open or remove any UPS cabinet internal cover there is a risk of exposure to dangerous voltages if power is connected to the UPS.



WARNING: DC cabling for the battery system(s) must be completed by a Kohler Uninterruptible Power Ltd. engineer or one of its approved service agents.

3.5.1 Safety notes

Please ensure you read and understand the following safety notes before you begin the UPS electrical installation.

1. All the operations detailed in this section must be performed or supervised by a qualified, authorised electrician.
2. Once the electrical installation is completed the initial UPS start-up must be performed by a qualified commissioning engineer, trained and authorised by the manufacturer.
3. Do not operate the UPS if there is water or moisture present.
4. When working on the UPS input power cables, you must ensure that the UPS input mains supply (and bypass mains supply in a dual feed system) is isolated at the mains switchgear panel and, where possible, locked out. Warning notices should be posted where applicable to prevent the inadvertent operation of the LV supply isolator(s).
5. For personal protection, ensure the following conditions are met prior to starting work on the equipment:
 - a) No mains voltage is present from the mains switchgear panel.
 - b) All loads are shut down and disconnected.
 - c) The UPS is shut down and voltage-free, with all internal power isolators OPEN (OFF).

3.5.2 Preparing the UPS power cabling

Before you connect the UPS input cables:

1. Ensure that the provided fuses and cables are in accordance with the prescribed IEC Standards or local regulations (e.g. BS7671).
2. Do not begin this procedure until the UPS is mechanically fully installed at its intended final location.

3.5.3 Connecting the UPS AC power cables

1. Gain access to the UPS power terminals by removing the safety cover(s) at the bottom of the UPS cabinet.
2. Connect an earth cable between the external mains switchgear panel and the UPS protective earth (PE).
3. Connect an earth cable between the external load switchgear panel and the UPS protective earth (PE).
4. If the UPS is to be cabled for a dual feed input ('split bypass' operation):
 - a) Remove the split bypass links – shown in figures 3.8 to 3.9.
 - b) Connect the UPS bypass mains supply cables from the mains switchgear panel to the UPS bypass mains terminals (2L1, 2L2, 2L3, 2N), ensuring the correct phase rotation – see figures 3.8 to 3.9 for guidance.

Note: If the UPS input mains and bypass mains are derived from the same supply source in the mains distribution panel there is no need to connect the bypass neutral. If the bypass mains is derived from a separate source, then the bypass neutral must be permanently connected – i.e. unswitched by the bypass mains supply circuit breaker/fuses.

5. Connect the UPS input mains supply cables from the mains switchgear panel to the UPS input mains terminals (1L1, 1L2, 1L3, 1N), ensuring the correct phase rotation – see figures 3.8 to 3.9 for guidance.

Note: The input mains neutral must be permanently connected (i.e. unswitched by the external bypass mains supply circuit breaker/fuses).

6. Connect the UPS output supply cables between the load switchgear panel and the UPS output terminals (3L1, 3L2, 3L3, 3N), ensuring correct phase rotation.

Note: The UPS output neutral must be permanently connected.

7. Secure the cables to the fixing rail located under the UPS connection terminals.

3.5.4 Connecting the battery cables

DC cabling for the battery system(s) must be completed by a Kohler Uninterruptible Power Ltd. engineer or one of its approved service agents.

3.6 Customer Interface Board



CAUTION: The customer interface board contain several DIP switches and jumper links which must be configured by the commissioning engineer. Once set, DO NOT touch.

The customer interface board is described in paragraph 2.5, with some of its common applications described in detail in paragraph 7.2. This section deals with the connection of the dry port interface connections taken to terminal blocks X1 - X4 which may be connected at this stage of the installation procedure.

All the on-board relays connected to these terminal blocks are rated at 60VAC / 8A and the Phoenix terminals can accept cables of 0.5 mm².

3.6.1 Customer dry-port interface terminal block – X1

X1 is a Phoenix spring terminal block and external connections should be made using s 0.5mm² cable.



Key Point: When the UPS cabinet is installed as part of a parallel system the customer interface board I/O is disabled in the 'slave' cabinets if the system 'Multidrop' application is enabled. Under such circumstances the required interface connections should be made to the board fitted in the 'master' module only.

Note that the 'Remote Shut down', 'On-Generator' and 'Customer defined' connections are described in Chapter 7.

Term	Contact	Signal	Function
X1/1		+3.3Vdc	Remote Shut down (Do not remove the factory mounted bridge until external Remote Shut down is connected)
X1/2		GND	
X1/3		+3.3Vdc	Generator Operation (NC = Generator ON)
X1/4		GND	
X1/5		+3.3Vdc	Customer IN 1 (Customer defined)
X1/6		GND	
X1/7		+3.3Vdc	Customer IN 2 (Customer defined)
X1/8		GND	
X1/9		+3.3Vdc	Battery temperature sensor (If connected, the battery charger current depends on battery temperature)
X1/10		GND	

Figure 3.13 Customer interface input connections (X1)

3.6.2 Customer interface output terminals – X2, X3, X4

Term	Contact	Signal	Display	Function
X2/1		ALARM	MAINS_OK	Mains present
X2/2				Mains not present
X2/3				Common
X2/4		Message	LOAD_ON_INV	Load on inverter
X2/5				Load not on inverter
X2/6				Common
X2/7		ALARM	BATT_LOW	Battery low
X2/8				Battery OK
X2/9				Common
X2/10		Message	LOAD_ON_MAINS	Load on Bypass Mains
X3/1				Load not on Bypass Mains
X3/2				Common
X3/3		ALARM	COMMON_ALARM	Common alarm
X3/4				No common alarm
X3/5				Common
X3/6		ALARM	MODUL_ALARM1	Module 1 alarm
X3/7				No alarm
X3/8				Common
X3/9		ALARM	MODUL_ALARM2	Module 2 alarm
X3/10				No alarm
X4/1				Common
X4/2		ALARM	MODUL_ALARM3	Module 3 alarm
X4/3				No alarm
X4/4				Common
X4/5		ALARM	MODUL_ALARM4	Module 4 alarm
X4/6				No alarm
X4/7				Common
X4/8		ALARM	MODUL_ALARM5	Module 5 alarm
X4/9				No alarm
X4/10				Common

Figure 3.14 Dry port (X2– X4) output connections

The customer interface board contains ten relays whose volt-free changeover contacts are made available to terminal blocks X2, X3, and X4. The relays are operated by the UPS status events identified in Figure 3.14, and can be used to interface with most forms of remote monitoring and alarm panels.



Key Point: In a parallel cabinet system ALL the outputs shown are available from the customer interface board fitted to the master cabinet. On those boards fitted to the slave cabinets only the 'summary alarm' outputs are active – i.e those outputs connected from X3/3 to X3/10 and X4/1 to X4/10.

3.7 Parallel-cabinet control and configuration



Key Point: The parallel interface board is only fitted to the cabinet if it is used as part of parallel cabinet system.



CAUTION: All parallel control cables must be installed by the commissioning engineer.

3.7.1 Parallel control bus

When several UPS cabinets are connected as a parallel system the modules' electronic control system communicate with each other by means of a parallel control bus which is connected between each cabinet and facilitates various system control functions such as load sharing, frequency synchronisation, and synchronised load transfer. The parallel control bus comprises a 25-way cable which is connected to an adapter board which is fitted to the parallel interface board.

The parallel adapter boards and cables are shipped as a 'paralleling kit' and must be installed by the Kohler Uninterruptible Power Ltd. commissioning engineer

Once the parallel bus cables are fitted, each cabinet is configured by means of a DIP switch to define its position in the parallel system – one UPS cabinet is configured to act as a 'master' with the remaining cabinets acting as 'slaves.' If the 'master' goes faulty the next cabinet (former 'slave') will immediately take over the roll of the 'master' unit and the former 'master' will switch off.



CAUTION: Once the DIP switches have been set, DO NOT TOUCH.

3.7.2 Multidrop

The optional 'Multidrop' feature, which is available only in a parallel cabinet system, requires a purpose designed 'Multidrop' cable to be connected between each module's customer interface board JD12. This will be connected by the commissioning engineer.

Note that when the multidrop feature is used, the I/O facilities of customer interface board in the 'slave' cabinets are all disabled, but the customer interface board fitted to the 'master' cabinet remains fully functional.

4

Operating Procedures

4.1 Introduction

4.1.1 Commissioning

The PowerWAVE 9000DPA UPS is a high quality, complex electronic system which must be commissioned by an authorised Kohler Uninterruptible Power Ltd. engineer before it is put into use.

The commissioning engineer will:

- check the UPS electrical and mechanical installation, and operating environment
- install and connect the UPS batteries
- check the UPS configuration settings
- check the installation and operation of any optional equipment
- perform a controlled UPS start-up
- fully test the system for correct operation
- provide customer operator training and equipment handover



WARNING: Kohler Uninterruptible Power Ltd.. will not accept responsibility for the equipment or the safety of any personnel if the UPS system is operated before it has been fully commissioned. The manufacturer's warranty will be invalidated if power is applied to any part of the UPS system before it has been fully commissioned and handed over to the customer.

4.1.2 Operating procedure summary

Under normal circumstances all the UPS modules in a multi-module system are turned on and operating in their 'on-inverter' mode. If one module fails in a 'redundant module' system the faulty module shuts down but it will not affect the remaining module(s), which will continue to operate normally and provide protected load power. The failed module can be replaced by a trained UPS service engineer without affecting the system operation.

If a UPS module fails in a 'capacity' rated (or single module) system, the load immediately transfers to the static bypass (in all modules) and is supplied with unprotected bypass mains power.

A parallel-cabinet UPS system requires the installation of an external maintenance bypass facility which wraps around the entire UPS system – this is optional in a single cabinet installation. The external maintenance bypass is bespoke to the installation and can be installed in a separate 'Maintenance Bypass' cabinet or switchgear panel (*see paragraph 3.4.2*). If an external maintenance bypass is installed you should familiarise yourself with its operating procedures before using the UPS operating procedures contained in this chapter.



CAUTION: In a multi-cabinet system always use the external maintenance bypass facility. DO NOT operate the cabinets' internal maintenance bypass switch (IA1).

Note: All the switches and control panel operations mentioned in this chapter are identified and described in chapter 2.

The commissioning engineer will hand-over the system in a fully working condition with all the UPS modules turned on and operating in the 'on-inverter' mode (or 'on bypass' mode, if appropriate).

4.1.3 General warnings



WARNING: The procedures given below must be performed by a trained operator.



WARNING: When the UPS system is operating on BYPASS or via the MAINTENANCE BYPASS SWITCH, the load supply is unprotected if the bypass mains supply fails. It is essential that the load user is informed of this possibility before you select these operating modes.



WARNING: When the UPS is shut down, power is still applied to the UPS modules and the cabinet input/bypass terminals unless the input/bypass mains is isolated at the mains switchgear panel. In a single cabinet installation it is not permissible to turn off the external input/bypass mains supply when the load is connected via the internal maintenance bypass switch (IA1) as this will also disconnect the load power.

4.2 Operating instructions

Under normal operating conditions all the UPS modules are running and operating in the on-inverter mode.

This chapter contains the following procedures:

- How to start the UPS system from a fully powered-down condition (*see paragraph 4.3*).
- How to start the UPS system when it is initially operating on the maintenance bypass (*see paragraph 4.4*).
- How to transfer the load to the maintenance bypass and stop the system (*see paragraph 4.5*).
- How to shut down the entire UPS system (*see paragraph 4.6*).
- Operating in 'on bypass' mode (*see paragraph 4.7*).

4.3 How to start the UPS system from a fully powered-down condition

IMPORTANT NOTE

In the following procedures, all references to the 'Maintenance Bypass Switch' apply to the internal maintenance bypass switch (IA1) in the case of a single cabinet if it is not connected to an external maintenance bypass facility.

If an external maintenance bypass facility is installed (standard in a parallel-cabinet system) all references to the 'Maintenance Bypass Switch' apply to the maintenance bypass switch in the external facility.



CAUTION: In a multi-cabinet system ALWAYS use the external maintenance bypass facility. DO NOT operate the internal cabinet maintenance bypass switches (IA1).



Key Point: In order to reduce the possible effects of any high inrush currents that might occur when the load is initially turned on, we recommend that you power-up the load when the UPS system is operating on maintenance bypass, as described in this procedure.

You should familiarise yourself with the operation of the external maintenance bypass circuit operation before using this procedure.

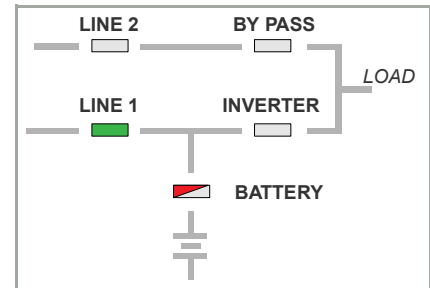
Initial conditions:

This procedure assumes the following initial conditions:

- The UPS maintenance bypass switch is open.
- The UPS system input supply isolated.
- The external UPS system output isolator is open.

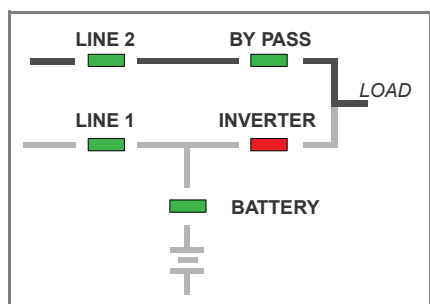
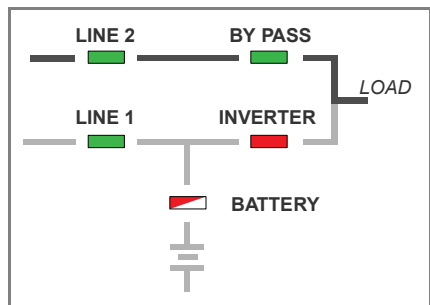
Power-up the load:

1. Connect the UPS system input supply.
 - a) Power will be applied to the UPS modules, but they will be turned OFF.
2. On every module control panel, verify that:
 - a) The LINE 1 LED is green.
 - b) The BATTERY LED is flashing red.
 - c) All other mimic LEDs are OFF
 - d) The LCD displays LOAD OFF , SUPPLY FAILURE.
If necessary press the RESET button to obtain this display.
3. Close the external UPS system output isolator.
4. Close the UPS maintenance bypass switch.
5. Turn on the load equipment.
 - a) The load is now powered through the maintenance bypass.
 - b) The module control panel mimic indications do not change.
 - c) The LCD displays MANUAL BYP IS CLOSED.
6. Press the RESET button.
 - a) The LCD displays LOAD OFF , SUPPLY FAILURE.



Start the UPS module(s):

7. Carry out steps 8 to 13 on each UPS module in turn.
8. On the module control panel, simultaneously press both ON/OFF buttons. The UPS module will begin to power up over approximately 60s.
9. On the module control panel, after 60s verify that:
 - a) The LINE 2 LED is green (red during initial start-up).
 - b) The BYPASS LED is green.
 - c) The INVERTER LED is red.
 - d) The BATTERY LED is flashing red.
 - e) The LCD displays LOAD NOT PROTECTED .
10. Close the battery fuses. (Internal in the DPA-50 and DPA-150 cabinets and in an external battery cabinet/rack in the case of the DPA250).
11. On the module control panel, verify that:
 - a) The BATTERY LED flashes green then changes to a solid green after a period of up to 5 minutes.
12. Close the parallel isolator switch (IA2).
13. On the module control panel, verify that:
 - a) The LCD displays PARALLEL SW CLOSED.
14. Before you continue, ensure that the indications on the module control panels of ALL modules are identical, and as described above.

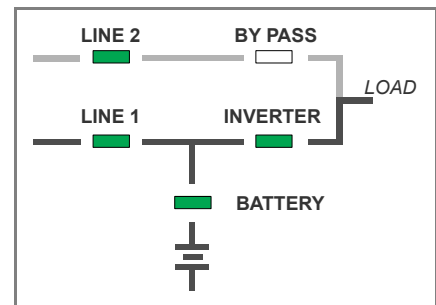


Transfer the load to inverter:

15. If the BYPASS LED is green (on ALL modules), open the maintenance bypass switch.

Note: If the BYPASS LED is not green, repeat step 7. Seek trained advice if it still fails to light green.

16. On the module control panel of any one UPS module:
 - a) Press the UP key once to access the menu system.
 - b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS then press the ENTER key.
 - c) Use the UP/DOWN keys move the cursor so that it is adjacent to LOAD TO INVERTER then press the ENTER key
 - d) The UPS module will transfer the load to the inverter.
17. On the module control panel of every UPS module, verify that:
 - a) The BYPASS LED is off.
 - b) The INVERTER LED is on.
 - c) The LCD displays LOAD PROTECTED.



Key Point: The UPS system is now operating in its 'on-inverter' mode and the load is fully protected.

4.4 How to start the UPS system from the maintenance bypass

IMPORTANT NOTE

In the following procedures, all references to the 'Maintenance Bypass Switch' apply to the internal maintenance bypass switch (IA1) in the case of a single cabinet if it is not connected to an external maintenance bypass facility.

If an external maintenance bypass facility is installed (standard in a parallel-cabinet system) all references to the 'Maintenance Bypass Switch' apply to the maintenance bypass switch in the external facility.



Key Point: If the load is not already turned on, turn it on now, while the UPS system is operating on maintenance bypass, before you continue with this procedure.

Initial conditions:

This procedure assumes the following initial conditions.

- The load is connected to the maintenance bypass supply.
- The UPS system input supply is connected to the UPS.
- The external UPS system output isolator is closed.
- The load equipment is turned on and receiving power through the UPS maintenance bypass.

Powering up the UPS system:

If the UPS system is operating on maintenance bypass it can be powered up using the procedure described in paragraph 4.3 "How to start the UPS system from a fully powered-down condition" beginning at step 7.

4.5 How to transfer the load to maintenance bypass

IMPORTANT NOTE

In the following procedures, all references to the 'Maintenance Bypass Switch' apply to the internal maintenance bypass switch (IA1) in the case of a single cabinet if it is not connected to an external maintenance bypass facility.

If an external maintenance bypass facility is installed (standard in a parallel-cabinet system) all references to the 'Maintenance Bypass Switch' apply to the maintenance bypass switch in the external facility.

The load can be transferred to the maintenance bypass supply and the UPS modules turned off when troubleshooting a 'system level' fault or replacing a UPS module in a 'capacity' rated system. This procedure is not usually part of the day-to-day management of the UPS system but normally carried out by a trained service engineer.

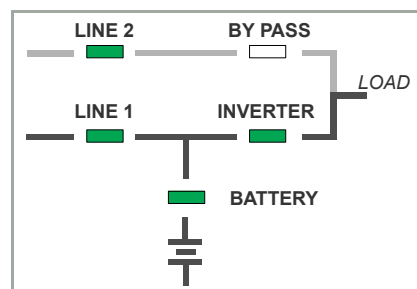


CAUTION: The load is not protected when operating on the Maintenance Bypass.

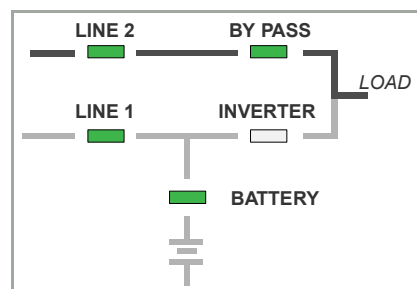
Initial conditions:

This procedure assumes one of the following initial conditions.

1. The UPS system is operating normally and all modules are on-inverter – continue with step 3:
 - a) The BYPASS LED is OFF.
 - b) The INVERTER LED is green.
 - c) The LCD displays LOAD PROTECTED.
If anything other than LOAD PROTECTED is displayed then press the RESET button, and if LOAD PROTECTED is still not displayed there is a problem with the UPS system and you should seek assistance!



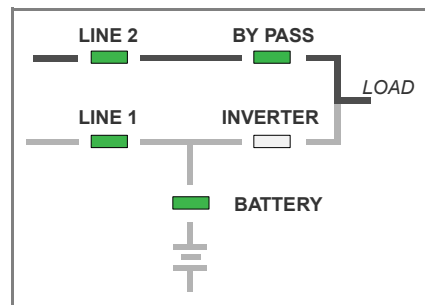
2. The UPS system is operating with the load on bypass due to a system fault, severe overload, loss of redundancy or operating in 'bypass' mode – continue with step 5:
 - a) The INVERTER LED is OFF.
 - b) The BYPASS LED is green.
 - c) The LCD displays LOAD NOT PROTECTED.



Transfer the UPS to on-bypass mode:

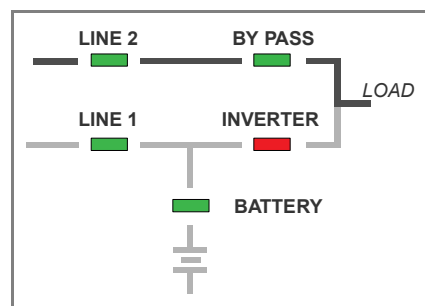
3. On the module control panel:
 - a) Press the UP key once to access the menu system.
 - b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS then press the ENTER key.
 - c) Use the UP/DOWN keys move the cursor so that it is adjacent to LOAD TO BYPASS then press the ENTER key.
 - d) All the UPS modules will simultaneously transfer the load to the static bypass.

4. On all module control panels, verify that:
 - a) The INVERTER LED is extinguished.
 - b) The BYPASS LED is green.
 - c) The LCD displays LOAD NOT PROTECTED.



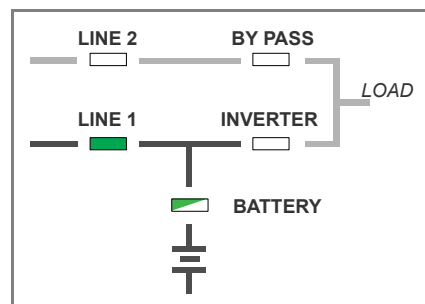
Transfer the load to maintenance bypass:

5. Close the maintenance bypass switch.
6. On the module control panel, verify that:
 - a) The INVERTER LED is red.
 - b) The BYPASS LED is green.
 - c) The LCD displays MANUAL BYP IS CLOSED.
 - d) The audible alarm activates.
7. Press the RESET button (*on all UPS modules*) to cancel the audible alarm.
 - a) The LCD display should indicate LOAD NOT PROTECTED.



Turn off the UPS module:

8. Carry out steps 9 to 11 on each UPS module in turn.
9. On the module control panel, simultaneously press both ON/OFF buttons and verify that:
 - a) All LEDs turn OFF except for LINE 1 and BATTERY (flashing green).
10. Open the module's parallel isolator (IA2).
11. Open the battery fuses.
(Internal in the DPA-50 and DPA-150 cabinets or in an external battery cabinet/rack in the case of the DPA250).



The load is now connected directly to the mains supply via the maintenance bypass circuit. In the case of a single cabinet installation using the internal maintenance bypass switch (IA1), the input/bypass supply isolators on the mains switchboard panel must remain closed to support the load, and the UPS cabinet's input/bypass and output power terminals will remain live. Where an external maintenance bypass facility is used, the UPS system input supply can be turned off – see the operating instructions for the bespoke external maintenance bypass facility for details.

4.6 How to shut down the complete UPS system

If the load does not require power for an extended period of time, the UPS system can be completely shut down using the following procedure.

1. Transfer the load to the maintenance bypass as described in paragraph 4.5.
2. Isolate all load equipment by opening the load fuses or circuit breakers at the load switchgear panel.
3. Open the maintenance bypass switch.
4. Open the external UPS system output isolator.
5. Isolate the UPS system input supply. Where used, refer to the operating instructions for the bespoke external maintenance bypass circuit for additional details of how to isolate the UPS mains supply if necessary.
6. The UPS is now voltage free.

4.7 Operating in 'on bypass' mode

When operating the UPS system in 'on bypass' mode, the load is powered normally through the UPS bypass ('on bypass') and switches to inverter ('on inverter') if the bypass supply fails.



CAUTION: When operating in the 'on bypass' mode there is a short supply break when the UPS switches to the 'on-inverter' mode, so this mode should be used only with a load that can withstand a brief supply break.

4.7.1 How to Turn ON the UPS in 'on bypass' mode

1. Use the standard operating instructions in paragraph 4.3 but do not perform the "Transfer the load to inverter:" stage (step 15 onwards).

4.7.2 How to Turn OFF the UPS in 'on bypass' mode

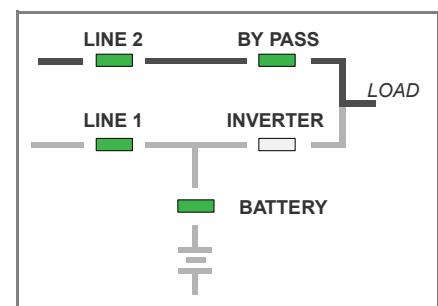
1. Use the standard operating instructions in paragraph 4.5 beginning at step 5 – as the load is already operating on bypass.

4.7.3 How to transfer between 'on bypass' and 'on inverter' mode

The UPS can be switched between the 'on bypass' and 'on inverter' mode through the module control panel load transfer menu.

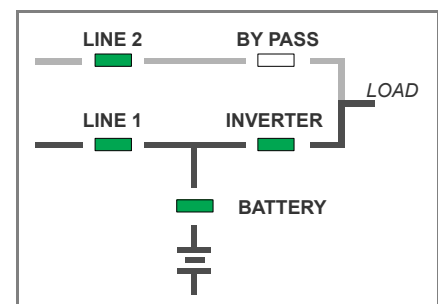
Transfer from 'on inverter' to 'on bypass' mode:

1. On the module control panel of any one UPS module:
 - a) Press the UP key once to access the menu system.
 - b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS then press the ENTER key.
 - c) Use the UP/DOWN keys move the cursor so that it is adjacent to LOAD TO BYPASS then press the ENTER key
 - d) All UPS modules will simultaneously transfer the load to the static bypass.
2. On all module control panel of every UPS module, verify that:
 - a) The INVERTER LED has extinguished.
 - b) The BYPASS LED is green.
 - c) The LCD displays LOAD NOT PROTECTED.



Transfer from 'on bypass' to 'on inverter' mode:

1. On the module control panel of any one UPS module:
 - a) Press the UP key once to access the menu system.
 - b) Use the UP/DOWN keys to move the cursor so that it is adjacent to COMMANDS then press the ENTER key.
 - c) Use the UP/DOWN keys move the cursor so that it is adjacent to LOAD TO INVERTER then press the ENTER key
 - d) The UPS module will transfer the load to the inverter.
2. On the module control panel of every UPS module, verify that:
 - a) The BYPASS LED is OFF.
 - b) The INVERTER LED is ON.
 - c) The LCD displays LOAD PROTECTED.



5 Maintenance

5.1 Introduction



WARNING: All the operations described in this chapter must be performed by trained personnel.

The UPS does not contain any user-serviceable part, however the UPS contains life limited components that require to be replaced at regular intervals. The maintenance requirements of the user are minimal other than to ensure the environment in which the UPS is installed is kept cool and dust free. A clean operating environment will help maximise the useful working life and reliability of both the UPS and its batteries.

5.2 Scheduled maintenance



WARNING: Preventative maintenance inspections involve working inside the UPS which contains hazardous AC and DC voltages, and should be performed only by an authorised engineer who has been trained by Kohler Uninterruptible Power Ltd.

It is essential that the UPS system and batteries receive regular preventative maintenance in accordance with the manufacturer's recommendation and any life limited components replaced at the required intervals and critical updates are performed to maximise both the useful working life and system reliability. When the UPS is commissioned, the commissioning engineer will attach a service record book inside the front of the UPS which will be used to log its full service history.

We recommend that the UPS system is maintained every six months by a Kohler Uninterruptible Power Ltd. trained engineer or approved service agent, who will complete the following.

5.2.1 Preventative maintenance inspection

Preventative maintenance inspections form an integral part of all Extended Warranty Agreements (maintenance contracts) offered by Kohler Uninterruptible Power Ltd.

During a preventative maintenance inspection a trained Kohler Uninterruptible Power Ltd. engineer will check and validate:

- | | |
|---|---|
| • Site/environment conditions | • Integrity of electrical installation |
| • Cooling airflow | • Rectifier/booster operation and calibration |
| • Inverter operation and calibration | • Static switch operation |
| • Battery status and condition | • Load characteristics |
| • Integrity of alarm and monitoring systems | • Correct operation of all installed options |
| • Condition of life limited components | • Manufacturer recommended updates |

5.2.2 System calibration

To ensure optimum UPS operation and efficient load protection we recommended that the system's operating parameters are checked and recalibrated where necessary.

During a system calibration a trained Kohler Uninterruptible Power Ltd. engineer will check:

- Rectifier operation and calibration
- Inverter operation and calibration
- Bypass operation
- Battery status and battery test

5.2.3 Battery maintenance and testing

The batteries should be checked and tested by a trained engineer every six months, depending on their temperature.

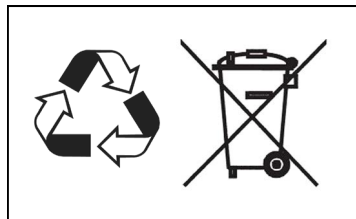
The battery test takes approximately two minutes to complete and can be performed only if:

- There are no alarm conditions present
- The battery is fully charged
- The UPS input mains supply is present

The battery test procedure can be carried out from the UPS front panel and performed irrespective of the UPS operating mode (ON - INVERTER or ON - BYPASS / ECO) and whether or not the load is connected.

Battery disposal and recycling

Batteries contain dangerous substances that can harm the environment if disposed of carelessly. If you have reason to change the batteries, always consult with your local environmental waste disposal organisations to obtain the recommended disposal and recycling information.



6 Troubleshooting

6.1 Alarms

If an alarm condition occurs, the red ALARM LED will illuminate on the module control panel and an audible alarm will sound. In this case proceed as follows:

1. Silence the audible alarm by pressing the RESET button.
2. Identify the cause of the alarm by viewing the EVENTS LOG in the main menu (*see page 17*).
3. In case of doubt, contact your nearest service agent or call Kohler Uninterruptible Power Ltd. on 0800 731 3269 (24Hr.).

IMPORTANT NOTE

Certain alarm conditions may 'latch-on' even after the cause of the alarm is no longer present. For example, if there is a brief mains failure during unattended operation the MAINS RECT FAULT alarm will activate and it may still indicate a fault condition even after the mains supply has returned to normal.

If any of the following alarms appear, the first action to take is to attempt to RESET it.

- MAINS RECT FAULT
- MAINS BYP FAULT
- BYPASS IS OK
- BYPASS IS NOT OK

If the alarm resets then it was probably caused by a transient condition and is no longer present; the UPS responded correctly and no further action is required. If it is not possible to reset the alarm, or if the alarm is repetitive, investigative action is necessary which may require assistance from the UPS Service department.

6.2 Menu, Commands, Event Log, Measurements,

When you seek service support it is important that you provide as much information as possible concerning the UPS problem as this will help expedite a swift and appropriate response. A description of the Menus, Commands, Event Log and Measurements that can be found on the module control panel is provided on page 17.

Paragraph 6.3 illustrates a list of the most common Alarms and Messages. As you step through the event memory make a separate note of each recorded alarm condition as this will help identify the cause of any problems.

6.3 Fault identification messages and alarms

Messages will not appear automatically on the LCD as they occur, but will be recorded in the Event Log, with the time and date of their occurrence.

Alarm Condition	Interpretation	Suggested Solution
MAINS RECT FAULT	UPS input mains power supply to the rectifier is outside prescribed tolerance.	The UPS input mains supply is too low or missing. If site power appears to be OK, check the external input supply circuit breakers etc.
MAINS BYP FAULT	Mains bypass mains power supply is outside prescribed tolerance.	The UPS bypass mains supply is too low or missing. If site power appears to be OK, check the external bypass supply circuit breakers etc.
OUTPUT SHORT	There is a short circuit on load side of the UPS output power terminals.	Check all output connections and repair as required.
OVERLOAD	Load exceeds the UPS rated power.	Identify which piece of equipment is causing the overload and remove it from the UPS. Do not connect non-critical loads such as laser printers, photocopiers, electric heaters, kettles etc.
OVERTEMPERATURE	The UPS temperature has exceeded the maximum permitted value.	Check that the UPS ambient temperature is less than 40° C. If the ambient temperature is normal call the authorised service centre for assistance.
INV. PHASE FAULT	The UPS inverter is faulty.	Call an authorised service centre for assistance.
SYNCHRON FAULT	The inverter and mains are not synchronised.	The frequency of the UPS bypass mains supply is outside preset operational limits and the UPS static bypass has been temporarily disabled.
BATTERY IN DISCHARGE	The battery is discharging and approaching the end of its autonomy.	Turn off the UPS load in a controlled manner before the UPS switches itself off to protect its batteries.
MANUAL BYP IS CLOSED	The maintenance bypass switch is closed and the load is connected to the unprotected bypass mains supply.	This alarm is only displayed if the maintenance bypass switch is manually closed. Attempt to return the UPS operating state to 'on inverter' as soon as possible to restore a protected supply.

6.4 Contacting service

Kohler Uninterruptible Power Ltd. has a service department dedicated to providing routine maintenance and emergency service cover for your UPS. If you have any queries regarding your UPS please contact us.

Kohler Uninterruptible Power Ltd.
 Woodgate
 Bartley Wood Business Park
 Hook
 Hampshire, United Kingdom
 RG27 9XA

Tel: +44 (0)1256 386700
 0800 731 3269 (24Hr.)

Email: ukservicesales.ups@kohler.com

We recommend that your UPS is protected by an Extended Warranty Agreement. An Extended Warranty Agreement ensures your UPS system is maintained to the highest standard to maximise the system's operational efficiency and reliability – it also guarantees prompt attention and service support if a problem occurs.

7 Options

7.1 Introduction

The PowerWAVE 9000DPA UPS system offers a range of monitoring and control interfaces that can be connected to external facilities management systems. Depending on the system configuration, these interfaces can be applied at 'UPS module', 'cabinet' or 'system' level.

Interfacing at UPS module level

A 'Smart Port' connector (JD-1), fitted to the front of each power module, provides an intelligent RS232 serial port which allows an individual UPS module to be connected to a PC and monitored by suitable software. This is a standard D-type, 9-pin connector with cable connection details shown in Figure 7.4.

Interfacing at 'cabinet' or 'system' level

A customer interface board, which is fitted to the lower right of each UPS cabinet, provides various means of connecting 'cabinet' and 'system' level UPS monitoring and control interfaces to external devices (see Figure 7.1).



Key Point: If the UPS is operating as a parallel cabinet system and the 'Multidrop' application is enabled, the customer interface board I/O is disabled in the 'slave' cabinet(s) and the interface connections should be made on the customer interface board fitted in the 'master' module only.

Customer Interface Board		
1	X1	Customer inputs (terminal block)
2	X2-X4	Customer dry port output (terminal blocks)
3	JD11	RS232 PC interface (Sub D-9 Female)
4	JD12	RS232 Multidrop (Sub D-9 Male)
5	USB	PC Interface
6	SLOT 1	Slot for SNMP (CS141 adapter)
7	SLOT 2	Slot for optional Modem/Ethernet card

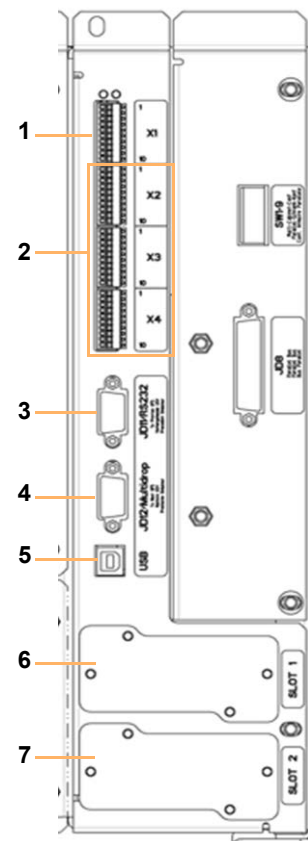


Figure 7.1 Customer interface board

7.2 Customer interface board

The customer interface board connections include:

- Dry-port inputs for customer remote control options (X1) – see page 38.
- Relay operated dry-port alarm outputs for remote monitoring (X2-X4) – see page 39.
- RS232 computer interface for remote monitoring/control applications (JD11)
- RS232 computer interface for multidrop (JD12)
- USB port for computer monitoring applications
- An SNMP/CS141 card slot
- An SNMP slot for Modem/Ethernet card

7.2.1 Remote shut down customer input

The remote shut down feature is enabled/disabled via hardware code which is set during commissioning. When it is enabled, the remote shut down input is connected to a normally-closed external contact which shuts down the UPS when it is opened.

We recommend that a terminal block is connected between the customer interface board and the remote shut down switch, as shown, so that the remote shut down contact can be effectively linked-out to allow the external circuit to be maintained or tested without shutting down the UPS.

Connect the remote shut down device using a screened cable with 1 pair (0.5 mm²) and maximum length of 100m.

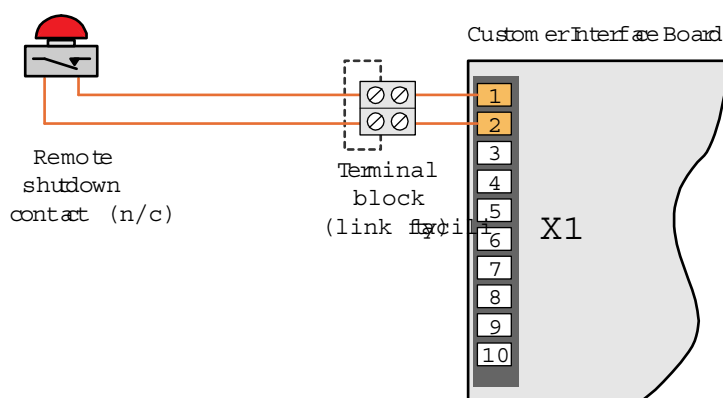


Figure 7.2 Remote shut down cabling



Key Point: In a parallel cabinet system only one remote shut down switch is required, connected to the customer interface board in the master cabinet. All the UPS cabinets will shut down when the remote emergency shut down switch is operated.

7.2.2 Generator ON customer input

The Generator ON input uses a normally-open contact which closes when the standby generator is running and supplying input power to the UPS.

When used, this facility enables an option to inhibit the battery charger and/or static bypass. Use a screened cable with 1 pair (section of wires 0.6 mm²) and maximum length of 100 m.

In a parallel cabinet system only one 'generator ON' input is required, connected to the customer interface board in the master cabinet. When the input is active it affects ALL the cabinets in the system.

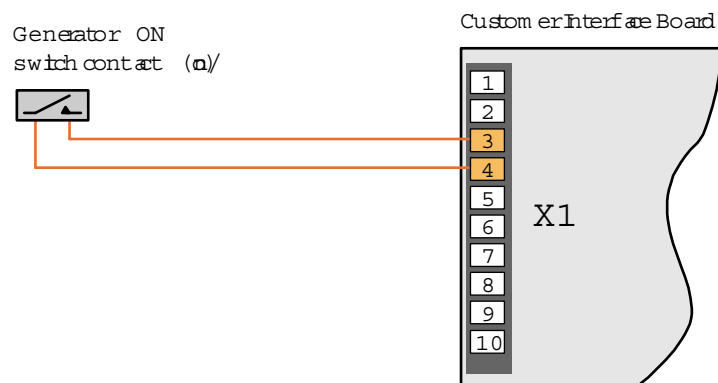


Figure 7.3 Generator ON cabling

7.2.3 Battery temperature sensor

If required, the battery temperature monitor will be installed by the commissioning engineer.

7.2.4 RS232 Computer serial interface – JD11 & USB

JD11 is an intelligent RS 232 serial port which allows the UPS cabinet to be connected to a computer for monitoring purposes. Its connector is a 9-pin female D-type and it can be connected to a computer using standard computer serial communications cable wired as shown below in Figure 7.4. The maximum length of the RS232 cable is 15m.

When used in conjunction with suitable software, this port allows the connected computer to continuously monitor the input mains voltage and UPS status, and display a message if there any UPS system changes.

The USB port on the customer interface board is connected in parallel with JD11 and output the same data stream.

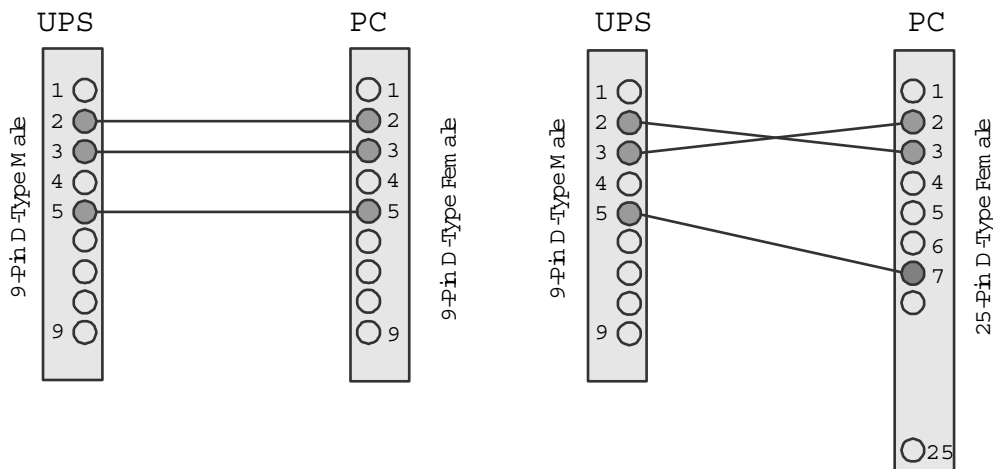


Figure 7.4 PC Serial port connector cable

7.2.5 RS232 Interface for multidrop – JD12

The optional 'Multidrop' feature, which is available only in a parallel system, allows the customer interface board in the master cabinet to collect data/messages from the other system cabinets via the cables connected to JD-12. The received data is then processed at a centralised point on the 'master' customer interface board and made available to the user directly on the RS232 port (JD1). It is also transmitted to the SNMP/CS141 card if inserted in the relevant slot.



Key Point: When the multidrop feature is used the I/O facilities of customer interface boards in the 'slave' cabinets are all disabled, but the customer interface board fitted to the 'master' cabinet remains fully functional.

If the multidrop feature is requested, the commissioning engineer will install the required kit of parts and test the system to ensure it is fully functional as part of the UPS commissioning procedure.

7.2.6 SNMP/ CS141 slots – SLOT 1/ SLOT 2

Simple Network Management Protocol (SNMP) is a world-wide, standardised communication protocol that can be used to monitor any network-connected device via a simple control language and display the results in an application running within a standard web browser.

The customer interface board contains two SNMP/CS141 slots; one is designed to house a Modem/Ethernet SNMP adapter card and the other a Modem/GSM adapter. SNMP connectivity can also be implemented using an external SNMP adapter connected to the UPS RS232 output (JD11), as shown in Figure 7.5.

An SNMP/Ethernet adapter contains an RJ-45 connector which allows it to be connected to the network using a standard CAT-5 network cable. Once connected, the UPS-Management software agent, which is already installed in the SNMP adapter, then monitors the UPS operation and outputs its data in SNMP format to the connected network. In a multi-module UPS system the SNMP interface can communicate 'system-wide' data or data for an individual UPS module.

The SNMP adaptor requires a PC with terminal connections, and for normal operation at least one Ethernet connection. The SNMP card enables event/alarm emails, server shutdown (with optional licenses) and other tasks and can also be integrated with BMS software over a local area network (LAN) for SNMP or Modbus information over IP. An optional card is available to enable Modbus communications over RS485.

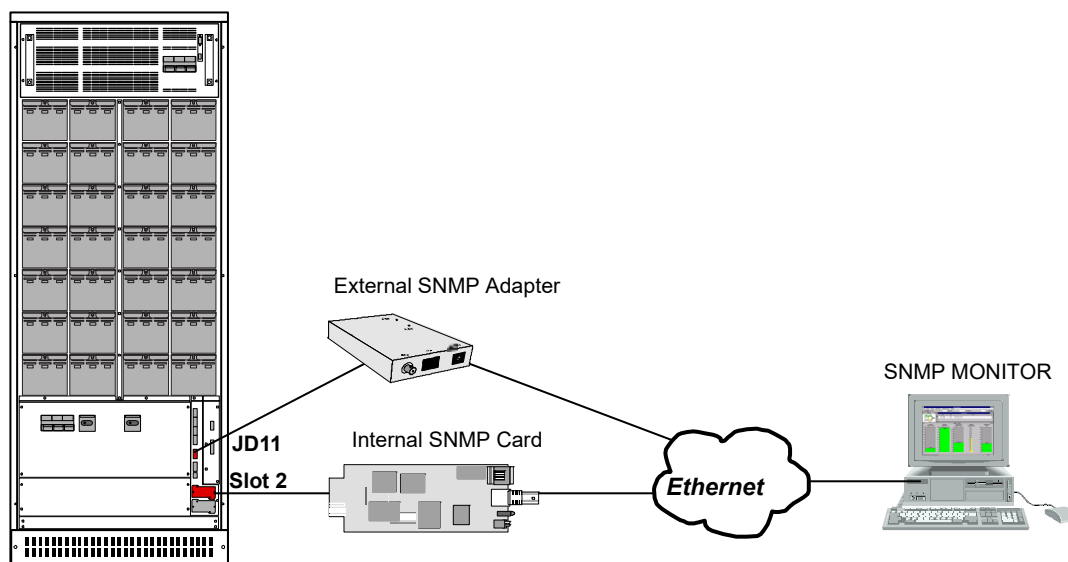

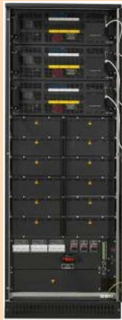






Figure 7.5 SNMP Internal and external SNMP adapters

8 Specification

8.1 Mechanical Characteristics

PW9000DPA Cabinet Rack		CLASSIC DPA-50	TRIPLE DPA-150	UPGRADE DPA-250
				
Capacity	Max.	1 module (30-45kVA) 280 x 7/9Ah batteries	3 modules (30-45kVA) 240x 7/9Ah batteries	5 modules (30-45kVA) no batteries
Max. Power connection	kVA	50	150	250
Dimensions (WxHxD)	mm	730x1650x800	730x1975x800	730x1975x800
Weight of Empty Cabinet	kg	262	239	205
Weight of Cabinet with modules and no batteries	kg	305 - 309 (with 1 Module)	368 - 379 (with 3 Modules)	420 - 439 (with 5 Modules)
Colour		Black (RAL 9005)		
DPA S2 POWER MODULES		DPA 30 S2	DPA 40 S2	DPA 50 S2
				
Dimensions (WxHxD)	mm	663 x 225 x 720		
Weight UPS Module	kg	43.1	45.3	46.8
Colour		Black (RAL 9005)		

8.2 DPA S2 Power module

INPUT CHARACTERISTIC		DPA 30	DPA 40	DPA 50
Output Rated Power per Module $\cos\Phi$ 0.8	kVA	30	40	45 ¹⁾
Output Rated Power per Module $\cos\Phi$ 1.0	KW	24	32	40
Input Voltage	V	3x380/220V+N, 3x400V/230V+N, 3x415/240V+N		
Input Voltage Tolerance (ref to 3x400/230V) for Loads in %:	V	(-23%/+15%) 3x308/184 V to 3x460/264 V for <100% load (-30%/+15%) 3x280/170 V to 3x460/264 V for < 80% load (-40%/+15%) 3x240/150 V to 3x460/264 V for < 60% load		
Input Frequency	Hz	35 - 70		
Input Power Factor		PF=0.99 @ 100% load		
Inrush Current	A	limited by soft start / max. In		
Input Distortion THDI		Sine-wave THDi = < 2% @ 100% load		
Max. Input power with rated output power and charged battery per module (output $\cos\Phi$ = 1.0)	kW	25.5	34.0	42.6
Max. Input current with rated output power and charged battery per module (output $\cos\Phi$ = 1.0)	A	36.8	49.1	62.1
Max. Input power with rated output power and discharged battery per module (output $\cos\Phi$ = 1.0) 8A charger (optional 15A charger)	kW	27.8 (28.1)	36.3 (37.4)	44.9 (46.0)
Max. Input current with rated output power and discharged battery per module (output $\cos\Phi$ = 1.0) 8A charger (optional 15A charger)	A	40.3 (40.7)	52.6 (54.2)	65.1 (66.7)
OUTPUT CHARACTERISTICS		DPA 30	DPA 40	DPA 50
Output Rated Power per Module	kVA	30	40	50 ¹⁾
Output Rated Power per Module	KW	24	32	40
Output Current In @ $\cos\Phi$ 1.0 (400 V)	A	35	46.5	58
Output Rated Voltage	V	3x380/220V or 3x400/230V or 3x415/240V		
Output Voltage Stability	%	Static: < $\pm 1\%$ Dynamic (Step load 0%-100% or 100%-0%) < $\pm 4\%$		
Output Voltage Distortion	%	With Linear Load < $\pm 2\%$ With Non-linear Load (EN62040-3:2001) < $\pm 4\%$		
Output Frequency	Hz	50 Hz or 60 Hz		
Output Frequency Tolerance	%	Synchronized with mains < $\pm 2\%$ or < $\pm 4\%$ (selectable) Free running $\pm 0.1\%$		
Bypass operation		An input voltage of 3x400 V $\pm 15\%$ or 190 V to 264 V ph-N		
Permissible Unbalanced Load	%	100% (All 3 phases regulated independently)		
Phase Angle Tolerance (With 100 % Unbalanced load)	Deg.	± 0 deg.		
Overload Capability on Inverter	%	125% load 10 min. 150% load 60 sec.		
Output short capability (RMS)	A	Inverter: 2.2 to 2.4x In for 40 ms Bypass: 10 x In for 10 ms		
Crest - Factor (load supported)		3:1		

¹⁾ Bypass rated current is 63A with the following overload capabilities: 110% continuously, 125% for 60 minutes and 150% for 30 mins.

BATTERY		DPA 30	DPA 40	DPA 50
Permissible number of 12V Battery Blocks	No.	40 - 50 blocks		
Maximum Battery Charger Current	A	8A Standard (15 A optional on request)		
Battery Charging Curve		Ripple free; IU (DIN 41773)		
Temperature compensation		Standard (temperature sensor optional)		
Battery Test		Automatic and periodically (adjustable)		
Battery Type		Sealed VRLA		
ENVIRONMENTAL		DPA 30	DPA 40	DPA 50
Audible Noise with 100% / 50% Load	dBA	70 / 63	74 / 67	76 / 69
Operation temperature	°C	0 to +40		
Temperature for Batteries	°C	+20		
Storage Temperature	°C	-25 to +70		
Battery Storage Time		Max. 6 months		
Max. altitude (above sea level)	m	1000m (3300ft) without de-rating		
De-rating factor for use at altitudes greater than 1000m above sea level (IEC 62040-3)		0.95 @ 1500m / 4850ft ASL		
		0.91 @ 2000m / 6600ft ASL		
		0.86 @ 2500m / 8250ft ASL		
		0.82 @ 3000m / 9900ft ASL		
Relative Air-humidity		Max. 95% (non-condensing)		
Accessibility		Totally front accessibility for service and maintenance (no need for side, top or rear access)		
Positioning		Min. 200mm rear space (required for fan)		
Input and Output Power Cabling		From the bottom on the front		
Efficiency AC-AC up to (pf = 1.0) (depending on Module power)	%	Load: 100% 75% 50% 25% Efficiency: 94.5% 94.5% 94% 93%		
Efficiency Non-linear Load (EN 62040-1-1:2003)		Typically up to 1% lower of above values		
Eco-Mode efficiency at 100% load	%	98%		
Heat Dissipation with 100% Non-linear Load per Module (EN 62040-1-1)	W	1532	2043	2553
Heat Dissipation with 100% Non-linear Load per Module (EN 62040-1-1)	BTU	5227	6969	8712
Airflow (25° - 30°C) with Non-linear Load per Module (EN 62040-1-1:2003)	m³/h	380	380	380

STANDARDS	DPA 30	DPA 40	DPA 50
Safety	Product Standards: IEC/EN 62040-1 Standards: IEC/EN 60950-1		
Electromagnetic Compatibility	Product standards: IEC/EN 62040-2 Standards: IEC/EN 61000-6-2, IEC/EN 61000-6-4, IEC/EN 61000-4-2, IEC/EN 61000-4-3, IEC/EN 61000-4-4, IEC/EN 61000-4-5, IEC/EN 61000-4-6,		
Emission Class	C3		
Immunity Class	C3		
Performance	IEC/EN 62040-3		
Product Certification	CE		
Degree of Protection	IP 20		